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GEORGIA SCHOOL OF TECHNOLOGY.

In 1888 by virtue of the wisdom and forethought of some of the prominent legislators of Georgia the School of Technology, in Atlanta, opened its doors to about 200 students. The equipment of the school at that time consisted of the usual accessories for practice in wood-shop, machine-shop, smith-shop and foundry. Until 1896 the school did not show any special signs of progress; in fact at one time the attendance was only 120, and the only degree offered was Bachelor of Science in mechanical engineering. Since 1896, however, there have been added the degrees of Bachelor of Science in electrical, civil and textile engineering and engineering chemistry. The institution has materially advanced in its scope, and during the last year 463 students matriculated in the various departments. The state of Georgia has increased the annual maintenance fund from \$20,000 to \$40,000, and the total income of the institution now amounts to \$53,000 per annum. The average cost per annum per student is about \$250, everything included. It is thus seen that technical training of high grade in all of the different departments is offered to students of the Southern States at a price far below what they would have to pay for the same advantages in the larger institutions of the north.

In 1897 President Hall, who is a West Point graduate, and who was elected president in June, 1896, advocated the department of textiles for the instruction of students in all the branches for the manufacture of cotton goods. The recommendation was followed up with considerable vigor, and in the same year the legislature gave \$10,000 for the establishment of such a department, conditioned on the friends of the school donating an equal amount in money or machinery. Within twelve months nearly \$50,000 had been raised in donations; half in cash and half in machinery. Since that time the success of the textile school has been without question. President Hall's greatest assistance came from Mr. Aaron French, of the A. French Car Spring Manufacturing Company, of Pittsburg, who gave material assistance in money toward making the department a success. In his honor it has been called the A. French Textile School. It possesses a material advantage over the other textile schools in the country in that the courses prescribed include shop work, mechanical drawing and some mechanical and electrical engineering. About 150 young men were enrolled in the textile school last year, and those who have finished the course are finding but little difficulty in getting employment as foremen and superintendents in the numer-

ous cotton mills which are now in operation in all parts of the Southern States.

The illustrations show the extent of the equipment in hand looms, power looms, carding, spinning, weaving and dyeing.

The courses in mechanical and electrical engineering are of high grade, and the apparatus and equip-

industries and manufactories which may flourish or are peculiarly fitted for the Southern States.

The annual catalogue shows the occupations of the young men who have graduated from the institution since 1890, and about 95 per cent of the positions filled are along technical lines. Possibly the most prominent of the graduates of this new factor of industrial

education is Mr. George Crawford, who is manager of the National Tube Works, at McKeesport, Pa., and who was the first student to receive his diploma from the institution. It is very probable that this institution would receive material assistance from patronage in the Northern States should the authorities see fit to advertise for such patronage; for two reasons, first, the splendid climate of Atlanta would be a great attraction to young men whose health might break down under our rigorous winters at the North; second, the expenses are so moderate as to be within the means of the ordinary man of affairs.

In addition to the technical courses offered, the students have the privilege of a dormitory system where every attention is paid to their comfort and convenience, both physical and mental. A department of physical culture is conducted on scientific lines, and it is the policy of the authorities to employ as heads of departments men thoroughly acquainted with their professions as specialists and instructors.

It is predicted that the institution will become a great factor in the development of, not only the state of Georgia, but of the entire South.

MOTOR-CARS IN JAPAN.

The writer recently visited the leading cities near the coast of Japan, and found enthusiasm concerning the introduction of automobiles at its height. One might be surprised at the interest in motor-carriages mani-

festing in Nagasaki and other places, but it must be remembered that the Japanese are far more enterprising to-day than they were formerly, and the sons and daughters of the "new" race are as desirous of keeping up with the times as the most cultivated Europeans.

When the horseless carriage was introduced, trouble was experienced at first in getting the machinery repaired in the event of a breakdown. Recently, however, machine shops have been established in which the equipments are such that the most complicated of motor-carriage fixings can be repaired and adjusted. This is the result of recent attempts on the part of American and European manufacturers to introduce their respective machines into Japan.

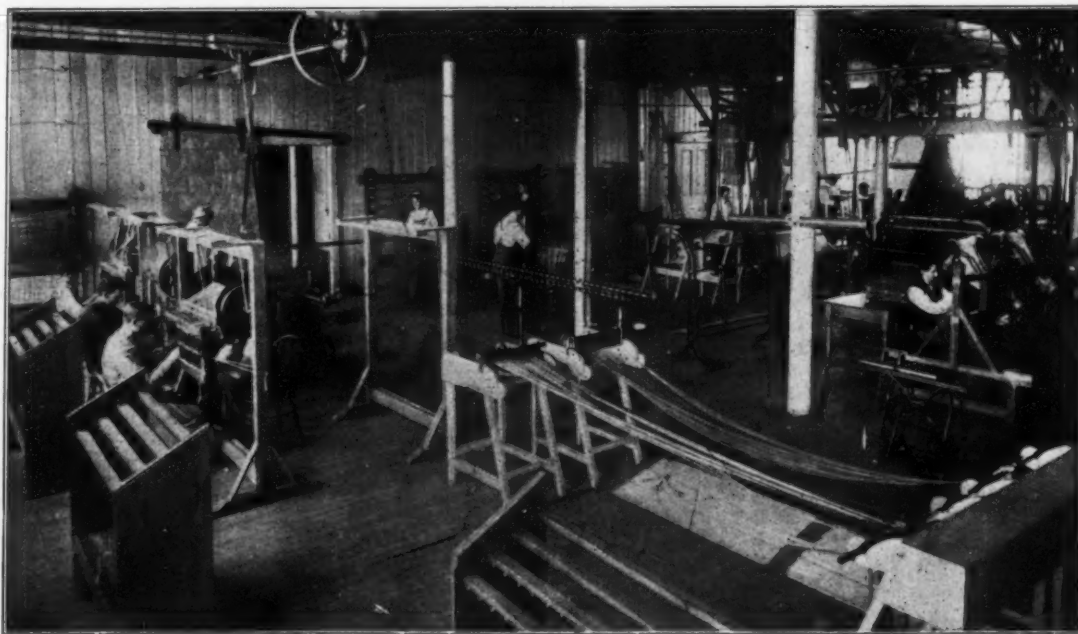
There are a great many persons in the



PRACTICE ON HAND LOOMS.

ment of laboratories and shops are unusually excellent and up-to-date. All the products which are manufactured are either used by the institution or placed on the market for sale. No work is thrown away, and in all the shops the work undertaken is from drawings made by the students, and shows all varieties of products, such as furniture, lathes, steam engines, pumps, bronze castings, etc.

Only lately the degree of Bachelor of Science in engineering chemistry has been added to the course, and will materially strengthen the institution and bring to it an increased patronage. It is the intention of the board of trustees and the president to continue the expansion of the different departments until technical training may be obtained in all the arts,



VIEW IN WEAWE ROOM.

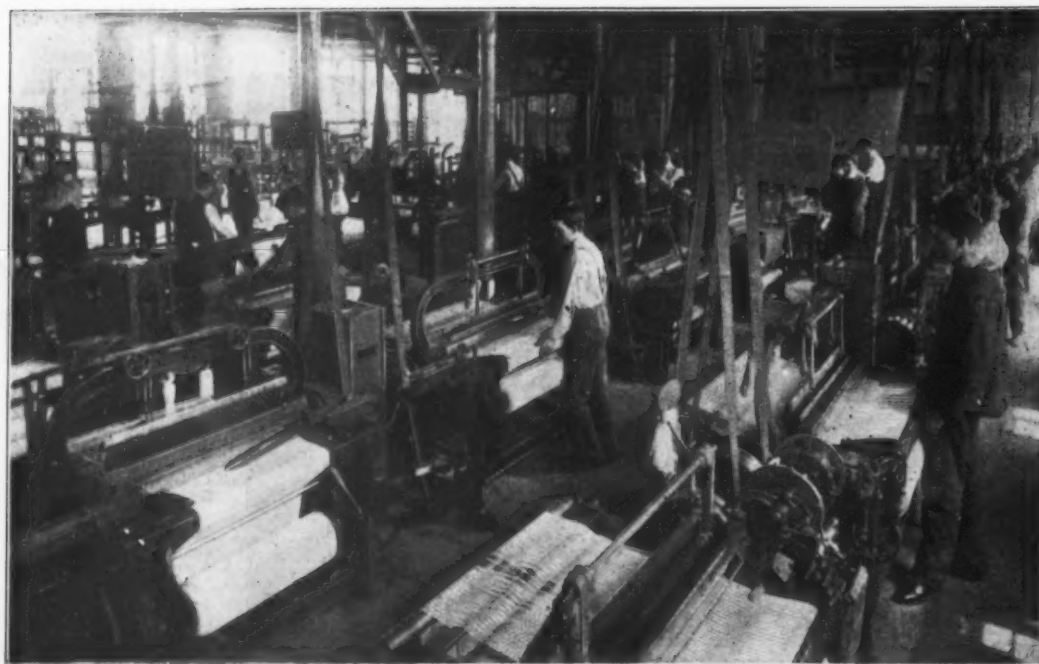
GEORGIA SCHOOL OF TECHNOLOGY.



SPOOLERS, TWISTERS, WARPERS AND SLASHER.



STUDENTS IN THE DYE HOUSE.



PRACTICE ON POWER LOOMS.

GEORGIA SCHOOL OF TECHNOLOGY.

Japanese empire who can afford to buy automobiles, and how to reach these people has been one of the problems with which the agencies have had to cope. There were numerous obstructions at first to importing foreign made motor-carriages into the country, but this prejudice has now been overcome in nearly all the leading commercial centers. Thus at Nagasaki there are agents who have established depots from which they sell different makes of motor-vehicles. The tariff duty on the imported vehicles is not excessive, and as good prices are obtained, the dealers have good incomes from the sale of the machines and the care and repair of the same. The machines which the writer saw in service and in the agencies in Japan appeared to come from all parts of the mechanical world. There were many English types, while the French designs were quite prominent. There were also American makes distributed in the sales stores. At some of the agencies the different makes of machines are drawn up in line, and one can inspect and compare the machines of different countries.

The Japanese laws are peculiar in many respects. Thus, for instance, if one takes his camera with him and tries to photograph people riding in automobiles, as the writer did, he is notified by the police that it is against the law to photograph anything in the empire. There are, however, not many laws restricting riding through public streets in motor carriages. I saw them running about at good speed everywhere. They are, as yet, a novelty in the cities and towns, and persons stop and gaze upon the speedy machines as they go buzzing through the streets. The principal troubles arise at the crossings, where the thoroughfares are overcrowded. Here the Japanese police often stop the automobiles while the crowd passes. Again, the police will sometimes hold the crowd back until the vehicles rush through. The streets of many of the cities and towns are too narrow for motor-vehicles, and, although there is no law prohibiting the machines from entering the streets, the drivers usually steer clear of them. Some of the streets are laid with rounded and pointed stones, which are disastrous to rubber tires, and drivers of automobiles avoid these as much as possible. Some of the country roads are in excellent condition and riding upon them is a great pleasure.—The Horseless Age.

ENAMELING AT PARIS.

On account of its many modern applications, enameling belongs to the industries whose processes are specially deserving of notice. From the humble stew-pan of enameled iron to the *cloisonné* of great value, from the slabs seen in public places to the dials of watches and the dishes of the pantry, enamel is in constant use and of constant utility.

It is a pulverized substance, finely ground, vitrifying in the fire, and containing various metallic oxides designed to impart color, which are incorporated in the material, covering and protecting it with a decoration not assailable by air or water. The first applications of enamel only had for their aim this preservation, and the original inventor sought, without doubt, to secure against frequent crumbling the earthen vessels he produced with much labor, after discovering the principles of the art of which we possess such marvels at the Louvre and Cluny.

Essentially practical, enameling must have been known from the earliest ages of humanity. The recent discoveries of M. Dieulafoy at Susiana have made us acquainted with the productions of Oriental enameling flourishing eight centuries before Jesus Christ.

Nearer to our times, but still remote, the Byzantine artists, appearing in the Occident in the Middle Ages, were for a long time the uncontested masters. With their three schools of the Rhine, the Meuse and Vienna, they maintained their supremacy until the tenth century, when the first workshops of Limoges made their appearance. This town soon became the center of European enameling, and the similar productions of Cologne, of Verdun, and of Liege sank into oblivion. From age to age, the artists of Limoges succeeded each other in celebrated dynasties and transmitted their traditions. During the period from the fifteenth to the seventeenth century, Galpais, Leonard Limosin, the Pericauds, the Reymonds, the Courts, the Courteys, the Landlins, the Noailhès, carried this art to its apogee of richness and delicacy.

But Limoges has lost its masters and its former renown. The shops of its artists have been replaced by its porcelain factories.

To-day Parisians have no need of a journey to study the processes of enameling. Numerous establishments have appeared in Paris, where the production of common ware and of art enameling may be met with.

The two kinds of enameling are similar. If the production of culinary articles requires a shorter time and is ruder, and, therefore, less expensive processes, the essential details are similar, and the study of the one allows us to form an idea of the other. To choose between them, the artistic enamel, whose manipulation is more delicate, and whose execution is more varied, seems preferable for study, because it allows of showing how the vitrifiable substance, while incorporating itself in the material, changes under the action of fire a plate of metal into a picture of incomparable color.

At Paris the enameling art is conducted in apartments. For instance, one manufacturer occupies the second story of an old house. The parlor has been converted into salesroom. There, ranged in glass cases, or classified in padded drawers, are the most varied productions of modern art—pictures, bonbonnières, powder boxes, watches, vases, cups, ladies' brooches, button-hooks, pins, handles for walking-sticks or umbrellas. On étagères are portraits of actors and statesmen, on the side of more decorative representations of our kings and the celebrated women of old France, while next to vases of modern style, the reproductions of the *chefs-d'œuvre* of Cluny add their tone of true art.

The principal of the establishment invites an inspection of his works. In his studio he is preparing elaborate designs in water colors. Proceeding with his work, he expatiates on the different styles of enamel: the *cloisonné*, the *champlevé*, the *mixed*, the *translucent*, and the *painted*.

For the *cloisonné* enamel, the artist places on the

plates to be enameled a very fine gold wire, following the lines of the design, and forms, by the intersections of the wire, compartments which are filled with enameling mixtures of various colors and then fired in the furnace. By the fusion, the enamels adhere to the metal ground and retain in their mass the gold wire delineating the designs. On account of the detailed extent of the preparatory work and the careful attention required, *cloisonné* enamels rank among the most delicate and expensive.

The preparation for the *champlevé* is also protracted. For this, the artist, after having traced his design with a point on a copper plate, raises (*levé*) with a graver, either the field (*champ*) of the design, or the ground around the design, and fills the parts he has hollowed out with the enamel. If the subject is reserved in copper to be engraved after the firing, the *champlevé* is called *en réserve*; if, on the contrary, the subject is raised to receive the enamel while the ground around is to remain of copper, the *champlevé* is called *cut in réserve*. For this the artist preserves in relief, in the subjects which he hollows out, an outline of the fine bands of copper which separate the different colors and correspond to the gold wire of the *cloisonné*. When the enameler has not preserved these small bands, he replaces them with gold wire, by the aid of which he divides his design in compartments, and the enamel is then called *mixed*.

These enamels are called *translucent* in which the designs are so incised on the metal that the light will appear through the ground and give to the eye the impression of glass-window miniatures, or else those in which, by another application of the process, the designs are engraved on the metal and we see through the vitrified coatings.

Painted enamels, without partitions or reserves, represent by their designs and colors alone pictures, portraits, flowers or ornaments. They are less complicated and easier of production than the other kinds.

In the enameling room are men and women grinding the colors, or designing, painting or gilding. Along the walls, on brackets, are vases, boxes and copper plates awaiting their turn. In the center of the room are large low tables, covered with cups, brushes of all forms and sizes, iron spatulas, boxes of gold and silver leaf, open and in use. Before the operators are large glass magnifying balls, facilitating the placing of fine gold *cloisons* (partitions) or the engraving of the *champlevés*. Numerous small objects, brooches, pins, powder boxes, lie before the enamellers. These are the objects of current make, a veritable stock for a bazaar, which the manufacturer classes as the lowest kind of work. They are of ready sale, of quick production, and of secondary interest, in comparison with the reproduction of celebrated pieces, or of the modern subjects which constitute articles of luxury.

To follow the type of one of these objects *de luxe*: First, the raw material, the copper which is to support the enamel, is bought in sheets of a special producer. It is cut to the desired dimensions; then the subject, say a vase, goes to the *repoussé* turners, who bring the sheet to the desired form with the aid of mandrels and burnishers.

For flat subjects, the piece receives the *emboutie*, or beating out. Enamelled pictures are never completely flat; they have a slightly concave surface, obtained under the repeated blows of a tool, which is intended to give the metal sufficient resistance to prevent it from warping in the fire after the *emboutie*. The copper plate is *recrouée*, that is, passed through the flame in order to burn off the grease left on its surface by the different preliminary handlings; then it is scoured in a bath of water and sulphuric acid, or it is cleaned by complete oxidation. Finally, it is dried, and is then ready for enameling.

The enamel, like the copper, is purchased outside. It is composed of borosilicates, which different oxides color. There are dealers in chemical products who furnish the enameler with his palette, a palette as rich and complete as that of the painter, and which he can increase at will by skillful mixtures. They are delivered in the form of small colored cubes—simple glass cubes—and are costly; thirty francs a kilogramme for white; four hundred francs for red having a base of pure gold. It is true that, for certain work, a white at three francs and a red at fifteen francs may be employed, but these have a copper base and neither the brilliancy nor richness of the other.

From the drawers where they are classified the enamels are taken as needed and delivered to young workmen, who grind them in agate mortars with the aid of pestles, also of agate, and wooden mallets. Reduced to powder, they are turned into porcelain mortars and worked up for a long time with water. The paste thus formed is purified by some drops of nitric acid poured into the mortar; then, after washing with plenty of water, it is ready for immediate use.

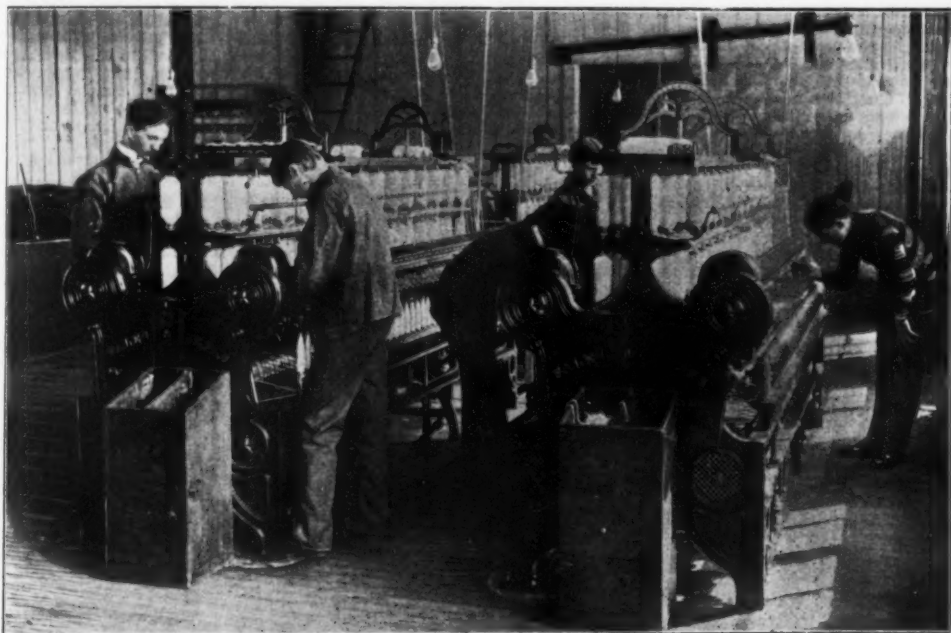
But colored enamel is not directly applied to the copper, which receives a previous coating of a kind of colorless flux. A female operative spreads, with the aid of an iron spatula, the semi-fluid pastes and sponges up the water that escapes. For coarse work, such as culinary articles, this first operation is performed by means of a sieve filled with enamel powder. The sieve is simply shaken over the surface to be enameled, which has previously been covered with a coating of gum. Then the articles are placed in the furnace in quantities.

The artistic enamels require more care, as can be seen by entering the kitchen of the apartment, which has been transformed into a chemical laboratory. Here is the oven, where the firing is done.

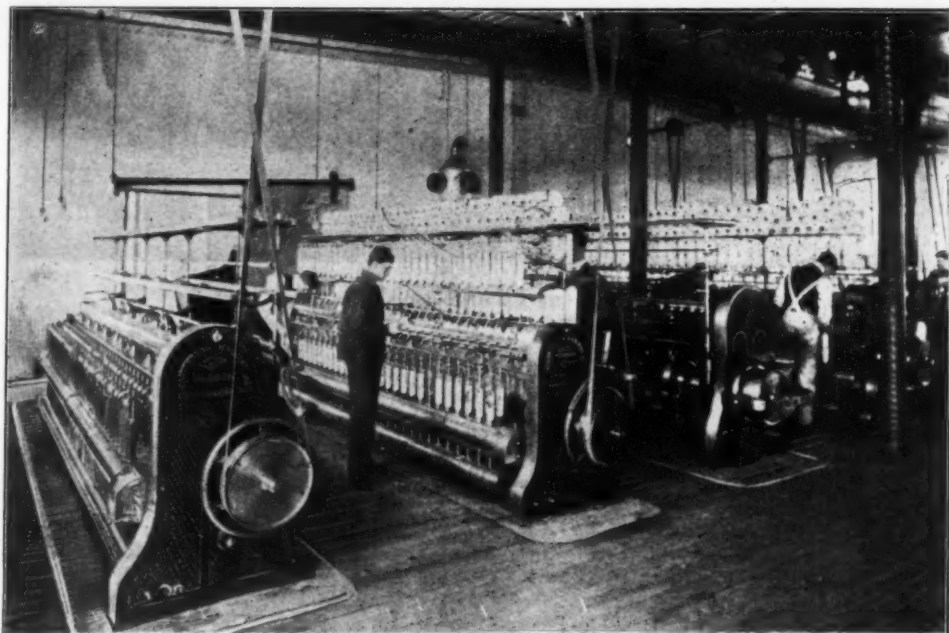
Placed against one of the walls, the furnace, of the kind called open muffle, illuminates the room phantasmagorically, casting gigantic shadows of artistic shapes. The plate, on which the first coating of enamel has been spread, is placed on a thin rundle of fire-clay, perforated with holes and smeared with red ochre, so as to prevent the adherence of enamel in the fusion. This is seized with long tongs and carried into the oven, which is instantly irradiated with blinding effulgence. A minute and a half, two minutes at most, are sufficient, and the enamel is vitrified. Then, drawn from the furnace, it is quenched on a table and assumes a tint of delicate rose, growing lighter until, when completely cooled, the metal seems covered with a colorless film like window glass.

On this first enamel the designer traces in crayon at first, then with pencil, the exact outlines of the subject to be reproduced. This design will serve as a

guide for the second enameler, who puts in the background, to the workman who arranges the foils, and to the artist who finishes the figure. Each coating of



PRACTICE IN RING SPINNING.



PRACTICE ON THE FLY FRAMES.



VIEW IN THE WOOD SHOP.

color goes to the fire before being covered by the following, and fifteen or eighteen times the same piece will have to leave the hands of the workman or the artist to return to the chief workman that is alone charged with the firing.

This operation, entirely depending on skill and experience, is the crucial test of enameling. The extreme care that must be exercised will be comprehended when we state that each firing, with the exception of the first, must be timed from half a minute to a minute, or up to four minutes at most, for the very largest pieces. A second too long might render useless two hundred francs of labor.

On the surface of the subject to be reproduced, a young operative arranges the foils, which he cuts of the proper dimensions from sheets of fine gold, silver, or platinum. The foils are designed for use under certain enamels to which they impart the metallic effects which astonish by their deep and weird brilliancy. Attached to the desired places with gum arabic, they increase the transparency of the greens,

pear, colorless and unshaped. These are reserved for the artist charged with finishing the subject.

This work of the artist is done with the aid of prepared colors, ground finer than those designed for the first coatings, and diluted, no longer with water, but with oil. For the flesh tints white is used, and at the finish some carnation with a general rose color.

The artist applies his colors, not, like the operatives, with a spatula, but with a brush or a fine copper point. He places a little of the paste on the most luminous parts, and spreads and renders the layers thinner and thinner on the shaded and half-tinted parts, and it is by leaving the dull background of copper more or less transparent that he obtains the full effect. He can work over and retouch at his liking, because each new application of enamel will mix so well with that which preceded it that the eye can perceive on the finished piece only a single soft and delicate tint, though ten or twelve layers have sometimes been superimposed.

The artists execute the work at their houses. They

pie or memento of the work of the Paris enamellers can procure a vase at twenty francs, or a pin at three francs.

But if enameling requires for certain objects of current use less expert workmanship than formerly; if, fallen to the utilitarian rank, it has no longer the character of precious rarity derived from the skill of artists who transmit their processes from father to son as jealously guarded secrets, it is at least interesting to know that the tradition of doing well is preserved with Parisian enamellers. Successors of a difficult art, which they endeavor to improve, they are forced to harmonize the increasing price of hand work with the modern necessities of low-priced production.—Translated from the *Magasin Pittoresque*.

THE USE OF RUBBER SUBSTITUTES IN GERMANY.

By JOHN S. McCLURG, M.S.

With the ever-increasing competition in the rubber industry there comes, from necessity, a corresponding increase in the number of appliances, methods, and other available means whereby rubber goods can be more economically produced without an appreciable reduction in qualities. To the rubber manufacturer this question appeals very forcibly, because it has been, and is to-day, a serious problem which requires not only brains, research, and a thorough knowledge of crude rubber, but, above all else, a scientific knowledge of the chemicals and other ingredients employed, and the chemistry of them. To suppose that any one can aimlessly mix together a heterogeneous mass of crude rubber, compound, shoddy, substitutes, and what not, and obtain successful results, is as gross an absurdity as to suppose that a quantity of building material can be thrown into an excavation and, within the night, be transformed, as if by magic, into a beautiful dwelling. However, the results obtained by some operators would seem to indicate that they have worked along just such lines.

The twentieth century has dawned upon the universe, and in the great race for industrial and commercial supremacy there is no place for the "all-around man," with hit-and-miss propositions. Every man must be a specialist, and must master his specialty. The success of our contemporaries, the German manufacturers of rubber goods, in producing a high class of rubber goods very cheaply is due very largely to the fact that their men are educated to do some particular thing, and to do it well. It is a fact that the German manufacturer in many lines produces a better class of goods, considering the cost of production, than the American manufacturer; besides, they have produced certain articles which Americans have not, as yet, been able to produce at any cost.

This article is intended to convey to American operators some idea of the reasons why these facts exist, and of the methods employed to obtain the end, as it was obtained by the writer by careful observation in Germany.

The Germans as a nation lead the world in chemistry and its application to the industries and the arts, and they have applied it to the rubber industry in a most scientific and practical manner. In this they have shown sound sense and good business judgment, because there are few industries that employ chemicals more abundantly, and few industries in which the proper chemicals can be more beneficially used than in the rubber industry.

The great cry of recent years has been for cheap-priced goods; consequently the operator has been thrown upon his resources to meet not only this demand in itself, but also the competition which naturally attends all such demands. New machinery has been introduced, electrical appliances installed, and an abundance of various ingredients introduced to lessen the cost of production. Chief among the latter is "shoddy," or reclaimed rubber, which has come into very wide use, and for a time it met the demand. However, not satisfied with existing conditions, the consumer demands something cheaper, and in consequence substitutes have been resorted to, to meet the requirements of the trade.

Of the latter, a very large number have been thrown upon the market, some of which possess real merit; still a large majority of them are bad, if not utterly worthless. There are some substitutes, however, which have been condemned as useless, yet which should they be properly manipulated, might prove of value.

A great part of the fault lies with the operators, because they have taken their stock recipes and cheapened them by adding substitutes without regard to the effect it may have upon the mixture chemically. This is a very serious error, and our German contemporaries have not fallen into it, because they do things more thoroughly than the average American, with relation to cause and effect.

The German rubber manufacturer makes his own substitutes in most instances, and therefore he knows what they contain in the matter of chemical ingredients. Fortified with these facts, he is prepared to reconstruct his rubber recipes, not only to overcome any objectionable features that the substitute may impart to them, but also that the substitute may benefit the mixture and become an ingredient of merit rather than an injurious one.

Substitutes improperly used render the rubber soft, and the goods very readily deteriorate in value, while if judiciously used, based upon a scientific knowledge of the subject in all its details, the manufacturer is able to produce a good quality of rubber that will wear well and give good satisfaction to the consumer, at a great reduction in cost. Nearly all German rubber recipes carry a large amount of substitutes, from the cheapest to the best grades of rubber; yet the stock is very tough, wears well, and lasts as long as most stocks containing no substitute. Many of their compounds contain a larger percentage of substitute than crude rubber, yet such chemicals are employed that the sponginess usually imparted to the mixture by the substitutes is overcome and its identity lost except as to the cost of the finished goods.

White and brown substitutes are employed with



THE MACHINE SHOP.



LOCOMOTIVE LINK MOTION, 30-INCH IRON PLANER, BRONZE DOORS—BUILT BY STUDENTS OF THE GEORGIA SCHOOL OF TECHNOLOGY.

GEORGIA SCHOOL OF TECHNOLOGY.

the blues, the reds and yellows. The skill consists in varying the foils according to the effect desired. Thus, to obtain a warm red, gold foil would be placed under red enamel, while, spread on a platinum foil, the same red would produce a rose color.

After baking and incorporation in the layer of colorless enamel, the foils receive the different colors which the pattern requires. By means of fine spatulas, the colored paste, mixed with water, is applied according to the design. Variable thicknesses and unequal reliefs will disappear in the next journey to the furnace. The layers of enamels and the firings succeed each other without fixed rules, at the discretion of the chief operator, who is left sole master of this work.

Meanwhile the piece takes body and assumes a form. It has reached a point in its execution where it is possible to perceive on the brilliant copper surface the warm and harmonious representations of the textiles and their surroundings. And now the flesh parts ap-

pear, colorless and unshaped. These are reserved for the artist charged with finishing the subject. Those that are proficient earn more than twenty-five francs per day, and without running any risk, because the perils of firing rest entirely on the manufacturer, to whom, on each new coating, he carries his work for the firing.

In the incessant renewal of the same operations, without speaking of the gold ornaments with which certain objects are framed in, interlaced and complicated by the tried hands of the decorator, it is not astonishing that an important picture requires a cycle of from one to three weeks. This protracted handiwork, added to the high price of the original materials, renders certain enamels costly. On the shelves will be found, among stock articles not specially ordered, plates priced at two hundred francs each, and pictures at a thousand. For subjects *de luxe* there is no limit. Some ordinary pieces are made quickly and sold at low prices. Those who desire merely a sam-

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equal success, which demonstrates conclusively that the Germans have mastered the substitute problem, even in these early stages of its development, and it is fair to assume that they will make greater discoveries in the not distant future. The substitutes most universally used are the brown and the white. French substitutes, made from oil, as the various cellulose and corn substitutes, have proven worthless. The German manufacturers are, however, constantly

year—that is, she must run at full speed while at sea and stay in port the smallest possible number of days in the year.

There is a vast amount of work to be done on a vessel every time she comes to port, and it all must be done in a hurry, for she must leave at a given hour to get high tide while crossing the bar. The ship must be cleaned throughout, the machinery put in complete repair, the cargo discharged and a new cargo

where they may be wanted, and usually, in a busy harbor like that of New York, enough empty ones to be filled at the coal docks, so as to keep the force at these docks employed regularly.

The coal barge being moored alongside of the ocean steamer, the problem then in hand is to transfer, say, 1,000 tons of coal from the former to the latter and to trim it in the bunkers in the shortest time possible, with the least cost for labor and with the least annoy

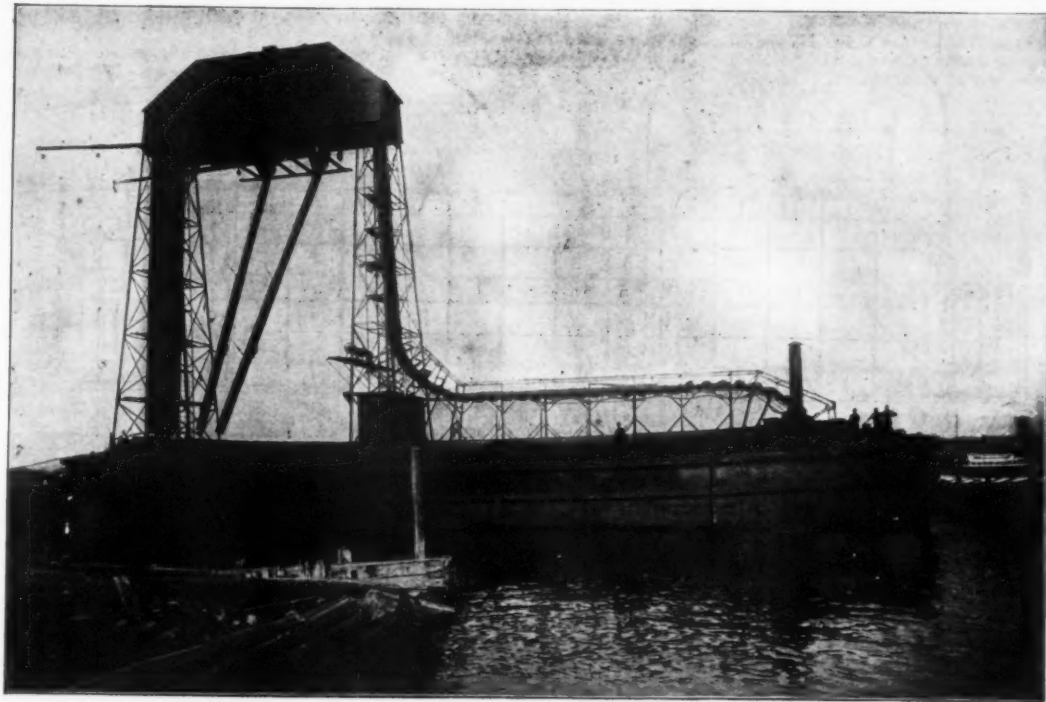


FIG. 1.—THE CLARKE AUTOMATIC COALING AND WEIGHING BARGE.

in search of new ingredients with a view to something better than has yet been found.

There can be only one explanation of these conditions, and that is the fact of their mastery of chemistry, and their scientific study of all details which affect their business and the doing well of all things worth doing.

These observations are given to show Americans what others are doing with an article in the infancy of what is certain to be a long and successful existence. The man who meets conditions practically and scientifically as they arise is the man who will lead in the present and future race for industrial supremacy, and herein is embodied a subject well worth a careful business-like consideration as a means to the end.—The India Rubber World.

THE CLARKE AUTOMATIC COALING AND WEIGHING BARGE.

From the time when a large Atlantic Ocean steamer arrives in port until she leaves again she is an unpro-

put aboard. Food and supplies of all kinds must be obtained and stowed away.

The most troublesome, disagreeable and time-consuming operation which is done on a ship while in port is that of receiving and stowing her bunker coal. A large transatlantic steamer requires from 2,000 to 3,000 tons for each voyage. Her time is too valuable to permit of her going to the coal docks and receiving it through inclined chutes directly from the coal bins, for, owing to the small openings leading to the bunkers, it cannot be taken on board any faster than it can be stowed away and trimmed in the bunkers, an operation requiring many hours. There are other objections to taking coal at the coal docks, such as the delay due to one vessel waiting for another when several vessels are needing coal at the same time and place, and the idle time of workmen, due to irregular arrival of vessels. It is therefore necessary for each vessel to receive coal at its own dock from barges lying alongside, during the time cargo is being discharged or loaded.

By the ordinary barge system of coaling steamers

ance from flying dust. By the usual method the coal is shoveled by hand into bags, baskets or iron buckets on the barge, and these are lifted by a "whip," operated by a steam winch on the steamer, lowered and dumped into the bunker opening, which may be either in the deck or in the side of the vessel. From the bunker opening, the coal, after dumping, slides down a chute or trunk into the bunker, where it is stowed into place by the trimmers. Of all kinds of work now done by human labor that of trimming coal in the unventilated bunkers of some ocean steamers is probably the most exhausting.

THE NEW METHOD.

We illustrate herewith a new method of coaling steamships, which has been in successful operation for the past year in New York harbor by the Automatic Coaling and Weighing Barge Company, 29 Broadway, New York city. By the new method the coal is contained in a steel barge of 1,000 gross tons capacity, divided by transverse bulkheads into several compartments or coal bins. The floor of each bin is

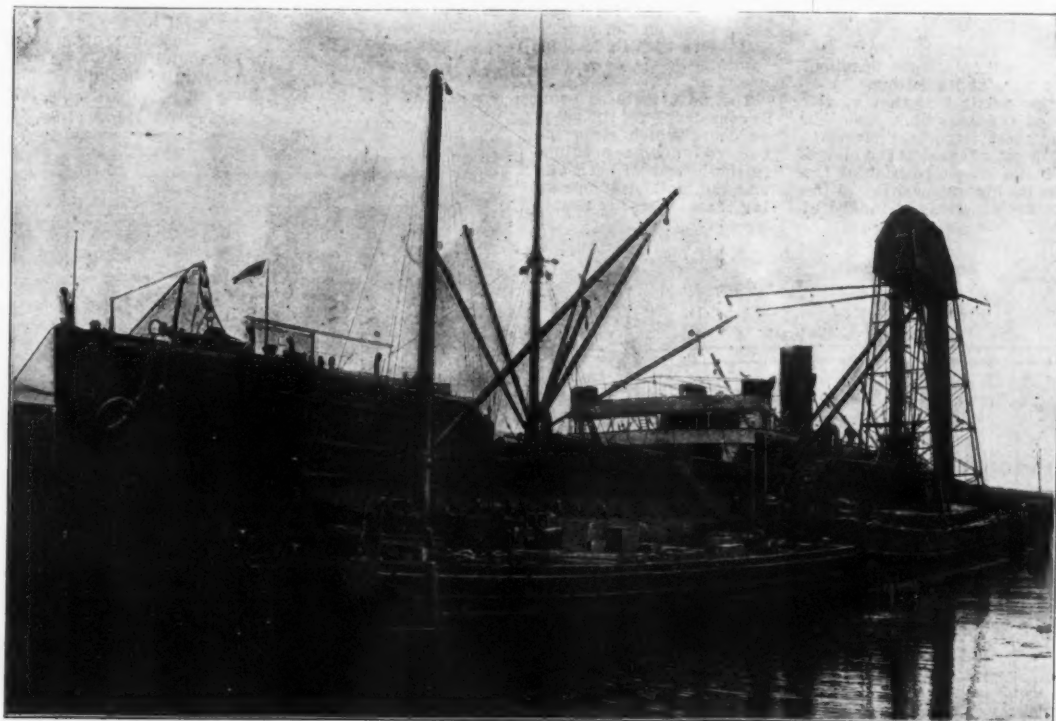


FIG. 2.—COALING A VESSEL.

ductive piece of property. She has cost a million dollars or more to build, and her officers and crew are constantly under pay, but she earns no money while lying idle in port. In order that a vessel shall earn the greatest annual profit for her owners she must make the greatest possible number of voyages in a

there is a fleet of barges in the harbor, which are filled, one after the other, at the coal docks, and are towed to the vessel requiring to be coaled. With a sufficient number of barges in the fleet there will always be enough of them filled with coal and available at a moment's notice to be towed to any vessel

raised above the bottom of the barge to accommodate a passageway which runs the whole length of the bins, just above the keel, and in which a train of buckets is drawn by an endless chain composed of flat steel links. There are three square openings in the bottom of each bin, closed by sliding doors, and

as each hole is opened the coal lying above it slides down into the buckets. The train of buckets is moved by means of a steam engine in the rear compartment of the barge, through the horizontal passageway, then vertically upward in a tower which contains two automatic weighing and recording scales, into one of which each alternate bucket is dumped. The coal then slides from the scales into two telescopic steel tubes, which deliver it into the bunkers of the steamer. The prin-

heavy, and supports a considerable load of coal. The lifting of each one is accomplished by means of two hydraulic lifting rams, each with a plunger 6 inches in diameter and 42 inches in stroke, which oscillate on trunnions. There being two lifting jacks to each movable section of the floor, it is essential that each one of the pair moves in harmony with the other, so that neither one can get in advance of the other, although the loads upon the two may be very unequal.

where it is actuated by a steam cylinder. Handles located above each coal bin on the upper deck control the clutches belonging to the levers of each of the gates, and also the valves of the cylinder, to rotate the shaft and open or shut at will any one of the gates when its clutch has been thrown into action.

Still another mechanical feature connected with the coal bin is a rotating picker bar, placed just above the gate at the bottom of the bin. The coal, in sliding

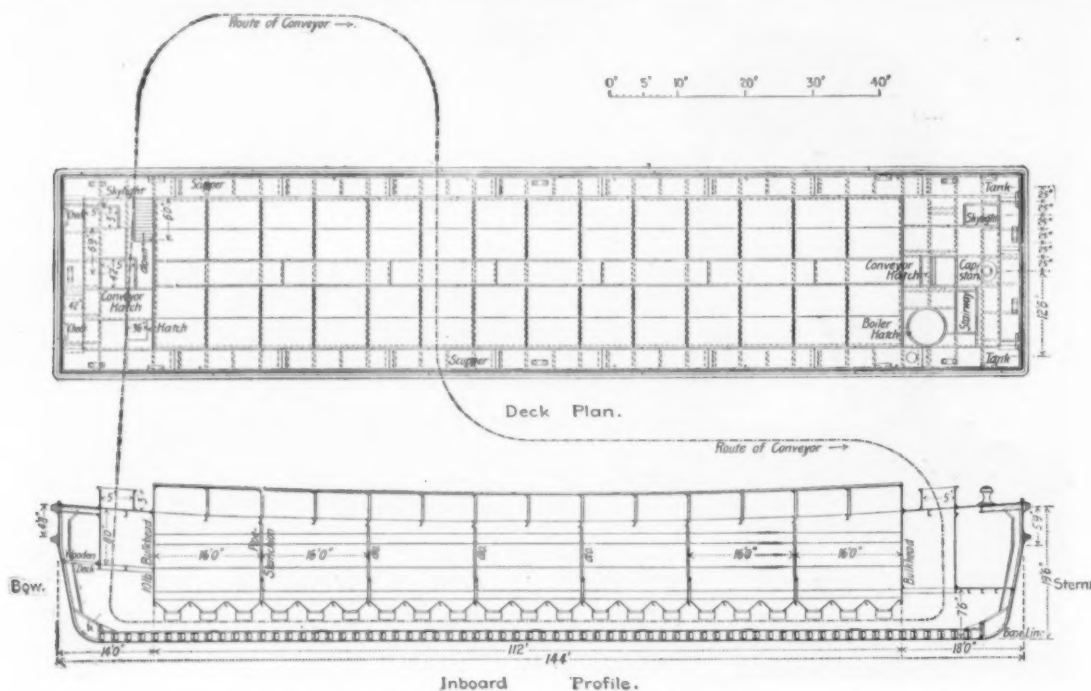


FIG. 3.—PLAN AND LONGITUDINAL VERTICAL SECTION.

ciple of the coaling barge is therefore similar to that of the well-known floating grain elevator, but the machinery is much heavier and contains many devices to facilitate the handling of a somewhat intractable material like coal.

The barge delivers the coal steadily at the rate of 125 gross tons per hour, and has been operated for several hours at a time at a rate of 135 tons. The whole operation is almost noiseless and free from dust, and it is accomplished entirely by the machinery of the barge, without any hand labor and without the assistance of any of the machinery or crew of the steamer.

DESCRIPTION OF BARGE.

Referring to the illustrations, Fig. 3 is a longitudinal vertical section and plan of the barge. Its dimensions are: Length, 144 feet; beam, 30 feet; depth, 18 feet from deck to keel; draft, loaded, 14 feet.

The rear compartment contains the boiler, engine, hydraulic pump, gearing and other appurtenances of a complete power plant. The forward compartment contains the quarters for the crew. The other compartments are all devoted to coal bins. Each bin is 16 feet long (in the direction of the length of the barge) and 28 feet wide at its greatest horizontal section, and each discharges its coal into three openings 22 inches long by 24 inches wide at its bottom.

Fig. 4 shows a transverse vertical section of the barge, taken through one of the coal bins, and this view shows several of the most important elements of the barge's mechanism. First of these is the elevating floor, which is shown in its lowest position at the right hand of Fig. 4 and in its highest position to the left. Each of the movable floor sections is hinged at

This is accomplished by means of an automatic two-way hydraulic valve, which governs the admission of water to both of the cylinders. As long as the outer edge of the moving floor section which is being lifted remains horizontal, the valve is in midposition, delivering water equally to each of the two cylinders; but the instant that one end of the outer edge becomes tilted upward the valve is moved so as to check or stop the water flowing into the cylinder nearest that end until the horizontal position of the outer edge is restored. This ingenious application of a single valve to control two or more hydraulic lifts connected to a single moving platform is adaptable to many other purposes besides the one for which it is used in this barge. It is the invention of Mr. Clarke, and is fully protected by patents.

Fig. 5 is a photographic view of a row of the hydraulic lifts under the moving floors of several of the bins. All of the lifts are supplied with water under pressure from a hydraulic pump and accumulator located in the compartment at the rear of the barge. The valves controlling each pair of lifts are located near them, but the handles by which they are operated are located at a convenient position above them on the upper deck, a long rod connecting each valve with its handle.

THE BIN GATES.

The next features connected with the coal bin to be considered are the gates or doors which close the two rectangular openings in the bottom of each bin, and the method of operating them. They are simply

down to the openings in the bottom of the bin, often becomes blocked by wedging or scaffolding itself across the inclined surfaces of the lower part of the bin, but it is easily started sliding again if it is touched with a bar or pick. This is the office of the rotating picker. It is driven by chain gearing from a shaft which is carried from the coal bins back to the engine room, and is, at will, connected or disconnected from the shaft by a clutch operated from the deck.

THE CONVEYOR.

Leaving now the coal bins, we come to the passageway underneath them, which contains a railroad track and a continuous train of buckets, called gravity buckets, which are pivoted and swung from steel links on both sides. The links are carried on wheels which run on the rails. The buckets are shown in Fig. 7. The lip of each overlaps the edge of its neighbor, so that no coal can drop between the buckets. As the buckets become loaded by passing under an opening in the bottom of one of the coal bins, they then pass under the edge of this opening, where the trimming above referred to takes off the surplus load and lets the buckets pass one after the other each with a uniform level load.

The buckets while pivoted in the links are kept in a horizontal position by an arrangement of guide rails. The train of buckets is moved along by means of the links to a point in the forward compartment, where

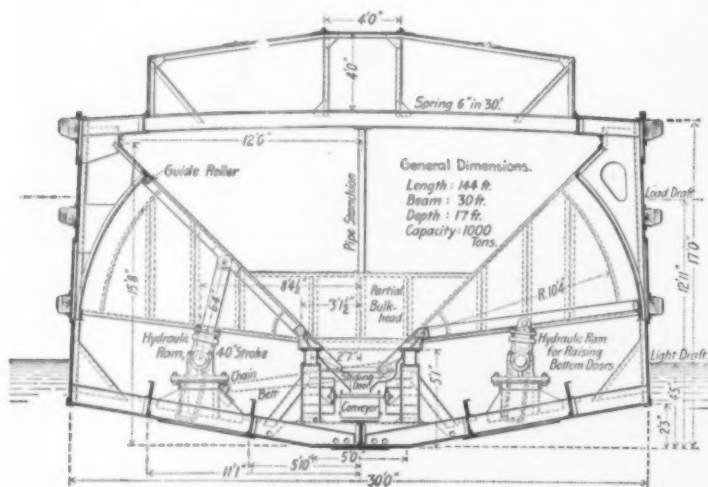


FIG. 4.—TRANSVERSE SECTION THROUGH ONE OF THE COAL BINS.

its lower edge, and at the outer edge almost touches the inner surface of the sides of the bin, which are formed in a curve, as is clearly shown in the drawing.

HYDRAULIC LIFTS UNDER BIN FLOORS.

Each of these movable sections of the floor is 16 feet long and 11 feet wide, is strongly built and therefore

flat cast-iron plates supported and operated on specially designed bearings by which the usual clogging of coal is eliminated. They are opened and shut by a system of bell crank levers, clearly shown in Fig. 6, which are operated through easily detachable jaw clutches, by means of a shaft which runs the whole length of the coal bins, back to the stern compartment,



FIG. 5.—HYDRAULIC LIFTS UNDER THE FLOOR.

its direction is changed to the vertical by the links passing 90 degrees around a wheel, and its motion then continues upward, guided by vertical tracks supported on the framework of a tower to the top of the latter, where the tracks bend to the horizontal, Fig. 8. The buckets then travel horizontally a short distance, when the coal in each alternate bucket is dumped into

a hopper leading to a weighing scale located just below. The second bucket of each pair is dumped when it reaches the hopper of a second scale, a little further along. The empty buckets then descend in a second tower to a point a few feet above the deck, then travel to a point above the stern compartment, into which they descend to the level of the passageway. In this compartment the links which carry the buckets, forming an endless chain, engage with a heavy sprocket wheel, which is driven by gearing from the engine.

POWER REQUIRED.

The work done by the engine when the barge is delivering coal at the rate of 125 gross tons per

scale rotates through an angle of 90 degrees, and dumps its coal into the hopper below, whence it slides through the telescopic tubes to the coal bunker in the steamer. The coal having fallen out of the scale, the counterweight brings the rotating cylinder back to its highest position, with the next compartment in place to receive coal, and with the cutting-off knife thrown back from the descending stream. A mechanical counting device on each scale registers the number of dumps, and the record is repeated by means of an electric connection to a register on the deck.

The barge being supplied with two scales, and running at the rate of 125 gross tons per hour, each scale will be dumped 250 times in a hour, or a little over

8,095,819 yen; and Belgium, 1,949,253 yen. In 1893 the United States supplied 7 per cent, Germany 9 per cent, and the United Kingdom 32 per cent of the total imports into Japan; in 1900, the United States supplied 21 per cent, Germany 10 per cent, and the United Kingdom 25 per cent. Going still further back, it may be said that in 1881 the United States supplied 6 per cent and the United Kingdom 52 per cent of Japan's imports; while, as above indicated, the United States now supplies 21 per cent and the United Kingdom 25 per cent.

The enormous increase in our exports to Japan since 1893 is distributed among a large number of articles. The Japanese figures show that imports of sole leather

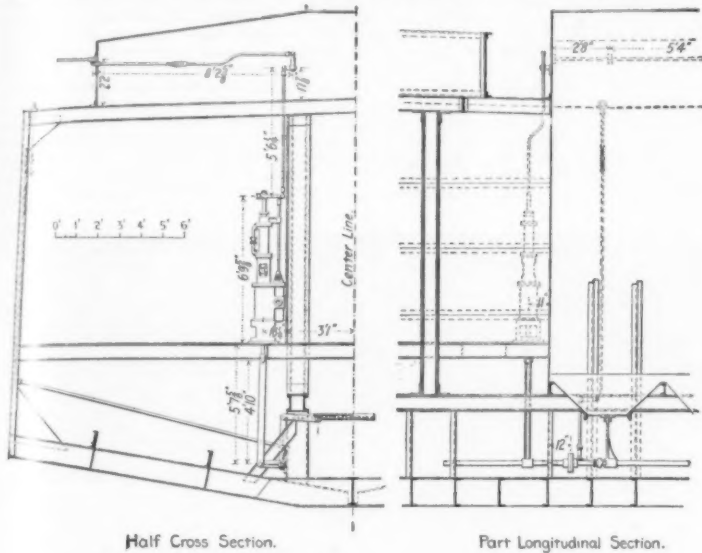


FIG. 6.—OPERATING MECHANISM OF BIN GATES.

hour is that of elevating this coal from the level of the track in the bottom to the level of the track above the scales, a distance of 75 feet, or $125 \times 2240 \times 75 = 21,000,000$ foot pounds, which is equivalent to 10.6 horse power, besides the overcoming of the frictional resistance of the moving buckets, links and gearing, which is about 1 horse power. A trifling amount of power of the engine is also used in operating the horizontal shaft which actuates the rotating pickers in the bins. The boiler furnishes steam for the engine, for the hydraulic pump which supplies water under pressure to the hydraulic cylinder used for moving the gate valves under the coal bins, and to the hydraulic cylinder under the movable floor sections.

The steam engine is an ordinary slide-valve engine with cylinder 8 inches in diameter and 10 inches stroke. Its speed when moving 125 tons of coal per hour averages 200 revolutions per minute, but it has been run as high as 250 revolutions. With boiler pressure at 60 pounds and 200 revolutions per minute, cutting off at three-quarter stroke it will develop about 13 horse power. The boiler is a vertical tubular, 58 inches diameter with 5-foot 6-inch tubes, and is rated at 50 horse power.

AUTOMATIC SCALE.

The automatic scale is a remarkably efficient piece of mechanism. It consists of a rotating cylinder divided by sheet-steel partitions into four quadrantal sections or compartments, each capable of holding $\frac{1}{4}$ ton, or 560 pounds of coal. In its normal position for receiving coal the partitions stand at an angle of 45 degrees with the vertical, so that the opening of one of the compartments is directly upward. The whole weight of the cylinder, together with the coal that may be in one compartment, is carried on two journals,

four times per minute, thus allowing ample time for filling without shock. The accuracy of the scale is quite remarkable. Repeated tests under the most rapid conditions of working have shown that its mean error does not exceed a quarter of 1 per cent. Its durability has also been thoroughly tested; the two scales on the barge, after a year's use, are apparently as good as new, and have thus far required no repairs.

This automatic weighing and registering of the amount of coal delivered by the barge is a matter of considerable importance to steamship owners. By the ordinary methods of obtaining coal, they must accept the weights given by the coal operators, and they have no satisfactory check upon the accuracy of these weights.

After the coal leaves the scales it slides down the telescopic chutes into the bunkers, where it is taken care of in the usual manner by the trimmers. By the use of a flexible end to the chute it is easy to carry the coal into any corner of the bunker, and thus greatly diminish the trimmers' labor.

The whole crew of the barge consists of six men—namely, the captain, who handles from the deck the levers operating all the machinery; the engineer and fireman; a man at the overhead winch to handle the chutes; a man to oversee the filling of the bunkers; a man in the scale house, who acts as a lookout, and the cook.

TRADE WITH JAPAN.

The remarkable growth in the exports of the United States to Japan and in the rank which she now holds in supplying the imports of that prosperous and rapidly developing country is shown by some figures just compiled by the Treasury Bureau of Statistics. The

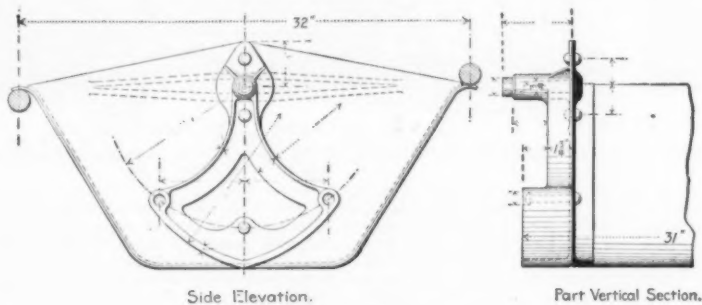


FIG. 7.—GRAVITY BUCKET.

the boxes of which are movable vertically a distance of 3 inches between guides, the bearing of the boxes on the vertical guides being a set of four wheels, to diminish friction. The weight of each of these boxes is supported by well-made and nearly frictionless chain, carried over two ball-bearing pulleys to a heavy counterweight, as shown in the cut. These ball-bearing pulleys take the place of the knife-edge pivots of ordinary scales. They are inclosed in dust-proof casings.

The angle of the hopper delivering coal to the scale is such that the coal slides down it at a moderate rate and the edge of the hopper is so close to the scale that when the compartment of the scale is full the coal is blocked in the hopper, and there is no coal falling through the air. The instant that there are 560 pounds of coal in the scale the counterweight is overbalanced, and the scale begins to descend, a knife actuated by a heavy weight suddenly cuts off the descending stream of coal, a latch is thrown open, the

Japanese statistical report, entitled "Annual Return of the Foreign Trade of the Empire of Japan," has just been received by the Treasury Bureau of Statistics, and presents the details of the imports and exports of Japan in the calendar year 1900. It shows that the imports from the United States have grown from 6,000,000 yen in 1893 to over 60,000,000 yen in 1900, and that the United States, which stood sixth in rank in the list of countries from which Japan drew her imports in 1893, is now second in the list, being only exceeded by Great Britain. In 1893 the imports into Japan from Great Britain were valued at 27,929,628 yen; those from China, 17,095,074 yen; from British India, 8,679,029 yen; from Hongkong, 8,268,071 yen; from Germany, 7,318,133 yen; and from the United States, 6,090,208 yen. In 1900 the list stood: From the United Kingdom, 71,638,219 yen; from the United States, 62,761,196 yen; China, 29,960,740 yen; Germany, 29,199,695 yen; British India, 23,516,350 yen; Hongkong, 10,659,855 yen; France,

from the United States have increased from 133,567 yen in 1893 to 782,862 yen in 1900; leather, other than sole, from 41,014 yen in 1893 to 185,855 yen in 1900; nails, from 20,204 yen to 1,422,655 yen; iron pipes, from 20,414 yen to 1,240,020 yen; paraffin wax, from 97,651 yen to 440,858 yen; timber, from 16,717 yen to 363,929 yen; electric light machinery, from 99,253 yen to 478,215 yen. In a large number of cases the import list of 1893 makes no mention of certain articles imported from the United States which in 1900 show large importations.

THE SYNTHESIS OF COAL.

The London Colliery Guardian says: "A step toward solution of the problem, synthesis of coal, appears to have been made in a communication to the International Geological Congress in connection with the Paris Exhibition by M. Lemiére, chief engineer of the Montvicq Collieries, who attributes the formation of coal to a bacterian action exerted by the cellulose of plants, taken in connection with an unintentional experiment made by Prof. Arth. of the Nancy University, under the following circumstances: A piece of sound lignum vite was used for the footstep of a 12 horse power turbine making 112 revolutions per minute, the whole of the revolving portion weighing about 400 kilogrammes. The end of the shaft resting on the lignum vite is of steel, and, without being actually immersed in water, the footstep is always damp. After

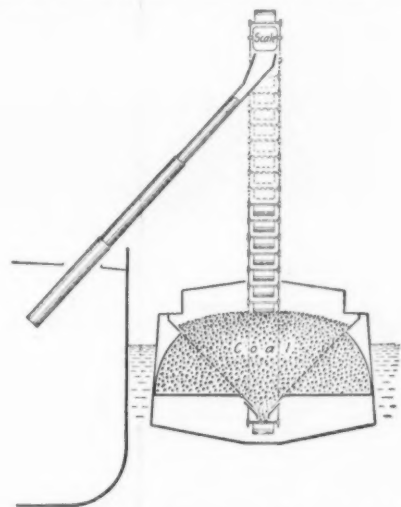


FIG. 9.—SKETCH SHOWING BARGE AND VESSEL.

six months' working the bottom of the wood was found to be intact; but the upper portion, on which the turbine shaft rested, had become transformed into a black substance, readily breaking into small pieces with bright fracture, and having all the appearance of some mineral fuels. Analysis of this black substance, dried in the air, showed powdered coke 56.88 and humidity 2.74 per cent, while after desiccation in vacuo 3.9 per cent of ash, 4.86 of hydrogen and 69.76 of carbon were found. By its composition and properties, observes Prof. Arth. this black product may be placed between the lignites proper and the more recent coals rich in oxygen, to which latter it approximates by its calorific power."

AMPLIFICATION OF WEATHER FORECASTS.*

By ALFRED J. HENRY, Professor of Meteorology, Weather Bureau.

The purpose of this paper is to promote the understanding of Government weather forecasts and to encourage the making of local predictions by persons whose working hours are spent for the most part in the open air.

The time at the disposal of the forecast official of the Weather Bureau at the central office in Washington city for the purpose of forecasting probable weather changes, cold waves, and severe storms is about thirty minutes in the morning and forty at night. It is impossible in this short time to do more than express the character of the anticipated changes for each state or district east of the Rocky Mountains in any but the most general terms. The local, or state forecast official, on the other hand, is concerned with but a single district. He is at liberty to amplify the national forecasts or to put forth a statement of his own, in which the anticipated changes may be given in as much detail as the conditions seem to justify.

Persons who use the forecasts constantly should cultivate the habit of carefully noting the weather changes in their respective localities, especially the sequence in which such changes occur, for it is only by acquiring a knowledge of local weather signs that

as used by the forecast, is less positive than "fair" alone. It signifies that the probability of fair weather over the whole district and for the entire period is not so great as when "fair" alone is used.

"Partly cloudy" is another expression that is used when the indications favor clouds but no precipitation. "Threatening" is used when in the judgment of the forecaster the weather will be overcast and gloomy, with the appearance of rain or snow at any moment, yet a measurable amount of precipitation is not anticipated.

A forecast of "rain" or "snow" may be expressed in various ways. In the late fall, early spring, and the winter season it is most commonly indicated by the single word "rain" or "snow," as the case may be, thus: "Rain to-night." And when used in this form it is expected that the rain will continue for several hours. In other seasons of the year any one of the following terms, viz., "local rain," "showers," and "thunderstorms," may be used. Local rain and showers are almost identical in meaning. The word "thunderstorm," of course, carries its own significance. Any one of these terms indicate that the rain will not be general over the whole state or district. The most marked feature of precipitation in the warm season, as compared with the cold, is its unequal distribution over

of weather which follows. In this way and without special effort a fund of weather wisdom is soon acquired which needs only to be properly correlated in order to serve a most useful purpose. The greatest advantage will naturally accrue to the individual who reads and accurately interprets, not only the Government forecasts, but also the local weather signs. In the remainder of this paper the local signs of falling weather will be briefly described.

CLOUDS.

Clouds are formed from the moisture that is always in the air, in varying quantities, even over the desert. Like the air itself, the moisture that is within it is invisible so long as it remains in the form of a gas. When a mass of air is cooled by any means whatsoever a portion of its water-vapor is condensed and becomes visible—a mist or cloud is formed. A familiar illustration of cloud formation in nature is afforded when a current of warm, moist air strikes a cold mountain. The colder surface of the mountain condenses some of the moisture that is in the air, forming a cloud which frequently obscures the top of the mountain and floats away in the prevailing winds. This simple phenomenon indicates to an observer on the leeward side of the mountain that a warm, moist current



FIG. 1.—CIRRUS CLOUDS.

Light, feathery clouds that float at an elevation of 4 or 5 miles above the earth's surface. When in the form of plumes with frayed or torn edges increasing cloudiness and rain or snow are indicated.



FIG. 2.—CIRRUS, MERGING INTO CIRRO-STRATUS CLOUDS.

A transitional form often seen when rain or snow is approaching. The cloud layer gradually thickens until the sky is obscured.



FIG. 3.—FAIR-WEATHER CUMULUS CLOUDS.

These clouds, it should be observed, have level bases and rounded tops without the dome-like structure of figures—a type of cloud often seen after a spell of rain.

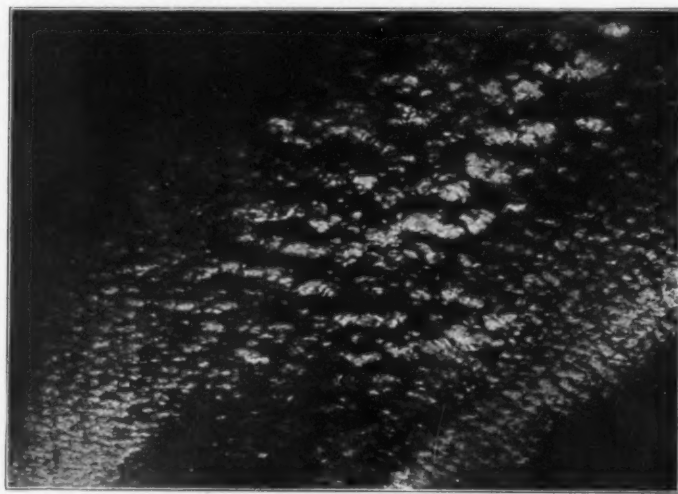


FIG. 4.—CIRRO-CUMULUS CLOUDS.

Small round masses of clouds usually at an elevation of 4 or 5 miles above the earth's surface. These clouds are typical of fair weather.

they can use Government forecasts to the best advantage.

DAILY WEATHER FORECASTS AND THEIR TERMINOLOGY.

The Weather Bureau issues from its Washington office two forecasts daily, at about 10 A. M. and 10 P. M., respectively. The observations on which the forecasts are based are made at 8 A. M. and 8 P. M., Eastern standard time. The morning forecast covers a period of twenty-four hours, beginning at 8 P. M. of the day on which the forecast is issued. The first twelve hours of the period is always referred to as "to-night;" the second is given the name of the day to which it may refer. Thus, "Fair to-night and Tuesday" would be the form of a forecast issued at 10 A. M. Monday. "To-night" in this case would begin at 8 P. M. Monday and run until 8 A. M. Tuesday, while Tuesday would end at 8 P. M. of that day, not midnight, as some might suppose. The forecast made at 10 P. M. is for a period of forty-eight hours. A forecast made on Monday night would take the form "Partly cloudy Tuesday and Wednesday." This forecast, it will be observed, does not apply to the night of either Tuesday or Wednesday.

"Fair weather"—that is, the absence of rain or snow—is indicated by several terms. The first of these is the words themselves. It may be used singly or be preceded by the word "generally." "Generally fair,"

* From the Yearbook, United States Department of Agriculture for 1900.

relatively small areas. A shower cloud may form and pass over several counties or it may dissipate within 5 miles of its origin. Indeed, we may say that it is only in exceptional cases that general and continuous rains fall in the summer season. In some seasons local rains may occur in some part of a State every day in the month, but the science of meteorology is not yet far enough advanced to delimit the path of a local shower and the exact time of its occurrence.

Forecasts of local rains, showers, or thunderstorms indicate that the conditions are favorable for the occurrence of precipitation in the district and for the given period.

"Clearing" is a word frequently used which carries a broader meaning than the word itself signifies, viz., the occurrence of precipitation in the early part of the period; thus "Clearing to-night" would indicate that rain or snow, whichever might be falling at the beginning of the period, would cease shortly thereafter and that the weather would be clear during the greater part of the time.

LOCAL SIGNS OF FALLING WEATHER.

Persons whose working hours are largely spent in the open air soon become familiar with the changing aspects of the sky and the condition of the atmosphere as to its moisture content, viz., whether relatively dry or humid. If careful observers of natural phenomena, they note also the shift of the wind and the sequence

of air, with probably rain or snow, is approaching. In some parts of the world the formation of a cloud cap on a mountain top is not an indication of precipitation, yet in the majority of cases it is believed to be a reliable prognostic of falling weather. In general, the formation of clouds after a clear spell is the first sign of coming rain. Unfortunately, there is no definite interval between the time of the first appearance of clouds and the occurrence of rain. Rain may not fall for several days after the first appearance of clouds, and, on the other hand, it may begin within two or three hours after the first cloud makes its appearance.

The various cloud-forms generally observed in the United States, with their especial significance, are given in our engravings.

THE TEMPERATURE AND MOISTURE OF THE AIR.

An increase in the amount of moisture in the air is indicated in various ways. It is especially noticeable to the senses when coupled with a high temperature. Man does not need a thermometer to tell him that the air is oppressively warm, nor a hygrometer to tell him that there is an unusual amount of moisture present. A pitcher of ice water on a hot summer day is not a bad sort of hygrometer. The pitcher is naturally cooler than the surrounding air, and consequently some of the water-vapor in the air is condensed and collects on the outside of the pitcher. It will be remembered that water-vapor changes to the liquid state when the

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air is cooled below a certain point. The principle illustrated by the pitcher of ice water is repeated on a grand scale in nature every time rain or snow falls. First, there is the cooling of the air and the formation of cloud, the latter being composed of minute particles of water; second, there is the further cooling of the cloud mass, so that its particles join to form small raindrops, which fall to the earth by their own weight. When a rain cloud strikes the top of a mountain, rain does not necessarily fall, but small mist-like particles of water are deposited on the relatively colder surfaces of the rock and other objects on the mountain sides and top. Those particles coalesce and run down the sides of the objects on which they are deposited precisely as frequently happens on a pitcher of ice water on a warm, humid day. If the mountains were warmer than the cloud mass there would be no condensation, but some of the moisture of the cloud would be evaporated and float away in the prevailing winds.

An unusual amount of moisture in the air in summer produces a feeling of closeness; physical labor is more enervating than when the air is dry and crisp. The change from sultry, oppressive weather is nearly always brought about by a series of thunderstorms, sometimes lasting over two days.

Summarizing the indications that may be drawn from the temperature and moisture of the air, it would appear that an increase in the amount of moisture in the air is a sign of change from fair to foul weather.

must be clear weather and unobstructed sunshine. It is easily seen, then, that all such winds must be most active in fair weather, and that when they cease, or fail to appear at the usual time, the atmosphere as a whole must have come under an influence greater than that which produced the diurnal winds.

In the open country or other exposed situation where the true direction of the wind can be determined, it should be noticed first, what is the prevailing direction of the wind in fair weather, and what is the direction from which storms usually come. The direction of the wind during the twenty-four hours immediately preceding the storm should be especially noticed. To do this a short journal or diary of the weather should be kept. The direction of approach of storms in the United States varies in different localities. It is quite important that each observer determine for his immediate neighborhood the shift of the wind with the approach of storms, during the colder months at least.

In the warm months the winds are light and rather variable, and changes in direction have not the same importance as in the colder months. The rain of summer generally occurs in connection with thunderstorms; it will be found that these are most frequent for a certain direction and with the wind in a particular quarter. Beyond the fact that more thunderstorms come from a westerly quarter than from any other direction, little can be said that will be of

(1) The changes in the aspect of the sky; (2) the direction of the wind before, during, and after the storm; and (3) the shift of the wind, whether with or against the sun.

The clouds that precede the storm by from twenty-four to thirty-six hours are almost invariably light, wispy cirrus, of the general character shown in Fig. 1. Soon after the appearance of clouds of this class a sheet cloud forms at a slightly lower elevation and gradually thickens until the sun is hidden. Fig. 2 illustrates the sheet cloud in the first stages of formation.

The subsequent clouds are much darker than those above mentioned, and appear to form at much lower elevations. When the sky becomes overcast the wind generally freshens, the temperature rises, and the air becomes humid; in popular speech, "it feels like rain."

LOW PRESSURE AND HIGH PRESSURE.

The weather experienced from day to day depends upon the frequency and the course followed by areas of low pressure, and the succeeding areas of high pressure which generally follow them. These are exceedingly variable, both as to direction and rate of movement. Some move rapidly from the Northeastern Rocky Mountain slope to the maritime provinces of Canada at a uniform rate, while others have a rapid rate of progression at the beginning, but quickly slow down and finally cease to move. There are, however, certain characteristics possessed by both highs and lows, which, if once fully understood, would greatly assist the individual observer in making a forecast of the weather for the morrow.

CONCLUSION.

The foregoing few generalizations apply equally



FIG. 1.—PRIEST SACRIFICING A VICTIM. FIG. 2.—SUN GOD AND PRIEST.

FIG. 3.—FIRE BASIN.

both winter and summer. In the colder months an increase in the temperature of the air above the average for the season, coupled with an increase in moisture, is a sign of rain or snow within twenty-four to forty-eight hours. In the summer an increase of temperature alone is not always an indication of rain. But these are not infallible rules. The old proverb, "All signs fail in dry weather," is as true to-day as when first formulated.

THE WIND AND ITS SUCCESSIVE CHANGES.

The wind is less prophetic in character than the clouds, since it is affected by the form of the land over which it blows. Thus, it has a tendency to blow up a valley in the daytime and in the contrary direction at night, no matter in what direction the valley may extend. Winds also have a tendency to blow toward and up the sides of a mountain slope in the daytime and down the side of a mountain at night, and this movement of the air generally extends for some distance out from the foot of the mountain on the level slopes. There are also the well-known land and sea breezes of all countries where, during the twenty-four hours of the day, the temperature of the land becomes alternately warmer and colder than that of the sea. These winds (valley, mountain, land, and sea breezes) are called diurnal winds. They are caused by differences in temperature that are not general, but confined to the valley or mountain slope of a particular locality. In order that these differences of temperature may arise there

value in forecasting their approach by the direction of the surface winds only. The coming of a thunderstorm can generally be foretold a few hours in advance by the form and movement of the clouds.

In the colder months, viz., November, December, January, February, March, and April, the winds are stronger than at other seasons of the year, and storms also move with greater rapidity. The signs of falling weather in the colder months are the formation of a high sheet cloud covering the whole sky, an increase in the temperature and moisture of the air, and the change of the wind to some easterly quarter. The precise direction that the wind takes, whether northeast, east, or southeast, varies for different localities and the direction from which the storm is approaching. In New England, the Middle States, and the Ohio Valley, northeasterly winds precede storms that approach from the southwest, and southeasterly winds precede storms that approach by way of the lake region. On the Pacific coast southeasterly and southerly winds precede rain storms. In Wyoming and other Northwestern States the heavy snowstorms of winter and spring generally come from the north or northwest with a strong wind from the same direction. The direction of the wind depends very much on the position of traveling storms that pass across the country.

The storms of the cold season have certain well-marked characteristics that should be easily recognized by every worker in the open air. These are:

well in all parts of the country east of the Rocky Mountains. They will be found most useful, however, in the middle and upper Mississippi and Ohio Valleys, the Lake Region, and the Middle States. As soon as they are thoroughly understood the local observer will be able to detect in the atmospheric changes, apparent to the eye or apprehended by the sense of feeling, the coming of an area of clouds and precipitation with its attendant whirling winds—warm on the front and right-hand side and cold in the rear and on the left-hand side.

THE SCULPTURES OF SANTA LUCIA COZUMALPA, GUATEMALA, IN THE HAMBURG ETHNOLOGICAL MUSEUM.*

By HERMAN STREBEL.

THE scientific committee of the Hamburg-American Celebration, planned for 1892, had intended to hold an exhibition, and Director Bolau, Mr. L. Friedrichsen, Superintendent C. W. Lüders, Dr. Michau, and the author of the present paper were associated into a sub-committee for that purpose. As everybody knows, the cholera broke out and rendered this promising part of the programme impracticable. It thus became necessary to make some other disposition of so much of the material collected as had been either

* Translated from the Annual of the Hamburg Scientific Institute, Vol. XI, 1899.—From the Annual Report of the Smithsonian Institution for 1899.

donated or purchased. It had all along been intended that our scientific institute should profit by such things, and so it happened, owing to the excellent financial management of the whole undertaking by the general committee, that our ethnological museum received the gift of a series of plaster casts whose originals are preserved in the Royal Ethnological Museum of Berlin.

Those originals came from Santa Lucia Cozumalhuapala, which is a place in the province of Escuintla, in Guatemala, on the southern or Pacific slope of the Cordilleras, below the Volcano del Fuego. The locality seems to have been settled after 1850 by Cakchiquels from the high plateau, who commenced coffee planting here. In 1860 the clearing of a piece of forest brought to light a number of sculptured blocks of stone. The commandant of the place, Mr. Pedro de Anda, considered the discovery of sufficient importance to be brought to the notice of the Guatemalan government, and a commission of inspection was dispatched to the spot. Unfortunately, their thorough report was never published, and has since not been found in the archives. Two years later, in 1862, the Austrian traveler, Dr. Habel, in the course of his extended explorations, arrived at Santa Lucia, and made drawings and descriptions of the antiquities that had been found up to that date. These were first published at the instance of Prof. Ad. Bastian, director of the Royal Ethnological Museum of Berlin, in Vol. XXII. of the Smithsonian Contributions to Knowledge, in 1878. Bastian had been informed by Habel, when the latter passed through Berlin, of the existence of important ruins in Guatemala, and when, in 1876, during his own American travels, his attention was called, in Guatemala, to the discovery in Santa Lucia, and he had seen it himself, he recalled what had been told him by Habel, who had meantime disappeared. Bastian, however, did not rest until he had traced him to New York and had taken the necessary steps to have his report and drawings published by the Smithsonian Institution. Before leaving Santa Lucia, Bastian, promptly recognizing the importance of the discovery, had purchased of the owner of the land for the Berlin Museum all antiquities which had been or should thereafter be discovered, an act for which Americanistic investigation must be particularly grateful to him. The most difficult part of the task still remained, however, to be performed, namely, the transportation of the treasures to the port of San José for shipment. Bastian had the happy thought of securing the co-operation of Dr. Hermann Berendt, who had been settled for some years in Guatemala, and who, being well acquainted with the country and the people, and at the same time an eminent linguistic and archaeological Americanist, was as much disposed to further the scientific research as he was competent to cope with its practical difficulties. The matter was taken in hand with the aid of Engineers Napp and Au, but greater difficulties arose than had been anticipated, for it turned out that the majority of the blocks were too heavy to be drawn to the coast by oxen over the rough roads. However, since they were only sculptured on one face it was ultimately decided that the greater part of their thickness should be sawn away. For this apparatus had to be secured and labor performed, and it is not surprising that it was not until the end of the year 1880 that the material was ready for shipment and that it was only in August, 1881, that it reached the Berlin Museum in good condition. Berendt, unhappily, did not live to take satisfaction in this final result. In the year 1878 an old complaint of his was so aggravated by the exertions involved in many journeys between his home and Santa Lucia that he died in April of that year, and Americanist research thus lost one of its truest adherents. Bastian, in his paper on "The Guatemalan Sculptures" in the publications of the Royal Berlin Museum for 1882 has given extracts from Berendt's letters relating to this industrious period so trying to the patience of all parties. For further information concerning the entire archaeological find in that neighborhood, of which only a portion, though no doubt the most important portion, has been transferred to Berlin, the reader may consult the above-named works of Bastian and of Habel, as well as papers by Gustav Eisen in the memoirs of the California Academy of Sciences, Vol. II., No. 2, and of Dr. Ed. Seler in the journal *II Centenario*, No. 26, Madrid, 1892. In these works the ruins are considered collectively. Eisen's memoir treats of the materials still remaining at Santa Lucia and its environs, of which Berendt sent descriptions and drawings to Bastian, the publication of which is much to be desired. Seler gives remarkable explanations of the principal pieces found at Santa Lucia.

A part of these treasures adorning the Berlin Ethnological Museum have now become a gift to our own in the form of excellent plaster casts. They are to be found on the north side of the upper story of the museum of natural history in the prehistoric collection. The author of the present account of them has deemed it incumbent upon him to publish something concerning their significance, so that the public, by understanding them better, may be led to take more interest in them.

The discoveries at Santa Lucia are remains of an important settlement which must have been destroyed long before 1522, the date of the plundering of the country by Alvarado; for had it not been so, we should have had notices about it from the Spaniards. That this destruction must have been a forcible one is proved by the disorderly position of the remains hitherto discovered, especially such as plainly formed parts of buildings. This is shown by the plan of the site published by Bastian in the Berlin *Zeitschrift für Ethnologie*, Vol. VIII., p. 322. The rank tropical vegetation had covered these remains and given them over to oblivion, until, centuries later, chance brought them to light again, and thus gave us a glimpse into a civilization previously quite unknown.

To the question: What race produced these monuments? no certain answer can be given. Their type is a new one to us. Comparing them with those of the Maya civilization, we find that they present differences so fundamental that they must be of another origin. The anthropological type of the figures exhibited, at least of those which represent inhabitants

of Santa Lucia, contrasts decidedly with those of the Maya sculptures, while the hieroglyphics characteristic of the latter are here wholly wanting. We are thus driven to seek their origin among the Nahoas peoples who formerly inhabited old Mexico, but of whom a part, as we learn from the remains, wandered south as far as the shore of the South Sea and into Central America, everywhere forming settlements of longer or shorter duration. Remains of these settlements have already been found. They are ascribable, with some degree of certainty, to the Nahoas civilization. It is, however, necessary to allow for the influence of the new conditions of life which the wanderers must have encountered, as well as for that of contact with foreign civilizations, in modifying original characteristics of their own and in introducing new elements—effects which must have become more marked the longer and the more undisturbedly those causes acted. Such must have been the case with the settlers of Santa Lucia, since the magnificence of the remains discovered bespeaks of itself a long period of prosperous development. The main outlines of the Nahoas civilization are preserved; but new elements, some of them attributable to Maya civilization, have been introduced and have been worked over in a peculiar way, so that a new type has been evolved. Before entering into details we may as well glance at the age of the Santa Lucia monuments. For this estimation definite data are afforded by Maya remains which narrate incursions of foreign hordes. According to these records the settlement must have taken place six or seven centuries ago; that is, in the thirteenth century of our era. It may have subsisted for a long time and may have been ultimately destroyed in contests with aboriginal Chakchiquels, Quichés, and other Maya races, which contests we likewise find recorded.*

Taken as a whole, the monuments of Santa Lucia exhibit, both in their technique and in their artistic conception and elaboration, a higher development than the corresponding productions of old Mexico, and approach the leading works of the Maya civilization, by which they may have been stimulated and aided. The proportions of the human body and the representation of its members are more correct than in the Mexican sculptures, and the bas-relief is executed with great taste. The pieces here considered generally represent priests engaged in performing rites of worship to different divinities; and the head of the divinity is so elaborated as to constitute the main object of the sculpture. The sex of the divinity is not indicated, at any rate not to our present means of discrimination. It may be that the mode of wearing the hair or the ornaments with which the divinities are loaded indicate their sex; but not having as yet found any figures of men and women with which they can be compared we are left in the dark upon this point. The particular function of each divinity is also difficult to determine, since attributes are employed with which we have no other acquaintance; so that it is only in some particular cases that analogy affords any clue to the nature of the god or goddess. Some details of the representations may now be considered in a general way.

We several times find close to the ornaments characterizing the divinity, and invariably before the mouths of the priests, as well as here and there among lifeless things, a sign in the form of a variously curved fillet, usually like an interrogation mark, with sundry double knot-like side excrescences. This sign must be equivalent to the tap-like sign with a bent end which is common in Nahuatl representations; and this latter we know certainly stands for smoke, breath, speech, or song. Whether or not in the present case any differentiation of signification is attached to the different shapes of the curve, the number of blades, or the differences between the persons or things to which the sign is attached cannot be decided at the outset. Not so clear is a shape which, starting from the front of the thick, stiff girdle of the priest, runs upward to a point and mounts in waves toward the divinity. It looks like the appearance of flames which, for example, surround the disk of the sun, and are, no doubt, meant for flames, although these latter are much smaller. It can hardly be fluttering ribbons ornamenting the girdle. Yet what a mounting flame should signify in this position, plainly connected with the stiff girdle, is more than we can guess at the outset. We further find occasional simple disks which in Nahuatl representations are undoubtedly numerals, each disk being a unit. Along with these, or alone, there are also larger disks, some of them with high rims, bearing various devices. These recall the way in which, in Nahuatl representations generally, days or periods of time, as well as names, are sometimes presented, although in the details the resemblance ceases. In the costume of the priests the following details are noticeable: Most of the body is bare; for, excepting the rich and varied ornaments for head, ears, and neck, the common breech clout of all old American peoples is his principal article of clothing. It is in the form of a long band going around the waist and between the legs, and forming a girdle. The ends hang down before and behind, and have tassels, or fringes. In addition to this, the priest wears a broad girdle whose contour surpasses the line of the body, and is obviously of stiff material, probably wood, since it appears to be carved. Hanging from the girdle there is also a sort of skirt, sloping away in front on both sides, where it has laces and fringes, and closed behind. There are many like this in the Codex Vindobonensis. As a leg ornament, we find below the right knee a galeon, or thong, with something hanging from it, or else a multiple rope of pearls; and both wrists seem to be adorned with strings of pearls. Upon the feet there are sandals; frequently only the left foot has a sandal, while the right is bare. One hand of the priest is uniformly covered with something like the head of a man or of a beast. Seler takes this for a mask, not for a real head; and certainly the style of representation is in favor of this interpretation, for it is entirely

* If the first settlement was in the thirteenth century, and if it endured long enough to develop an original type of civilization and to become rich enough to erect magnificent monuments, it could not well have been destroyed without a long struggle, and there would seem to be scant time for every vestige and memory of it to disappear before 1522.

unlike the realistic heads which the high priest and his assistants in Fig. 1 carry in their arms. The latter must be the heads cut off of the sacrificed men. Whether these masks are also to be regarded as offerings is doubtful, although the arm which carries one of them is usually raised toward the divinity, and seems to hold out something to him. But why should the sacrifice itself be shown in the one case and in the other only its mask? It may be that the mask is the distinctive mark of the priest, and has some reference to the divinity whom he serves.

After these general explanations, short descriptions of the single pieces must suffice. Among the originals of the Berlin Museum there are eight blocks which have approximately equal dimensions. Habel, who measured them in their original condition in situ, gives the height as 12 English feet, the breadth of the sculptured surface as 3, and the thickness of the stone as 2 feet; and he remarks that the face of each is plane in the lower 3 feet, so that the sculptured part is only 9 feet high. The blocks must have stood on end, and probably, with open interspaces, formed the façade of a temple or temples. For, had they been joined together, the sculpture would, in the ornamentation or somewhere, have been continuous from block to block; while, in fact, each is a separate representation, having, in some cases, a border of its own. There is no further connection between them than that of the subjects they represent, which are all religious performances, especially the worship of different divinities. This again agrees with the hypothesis that the blocks are remains of temples.

Of these eight blocks our museum possesses casts of the sculptured faces of three only, the first three of the following enumeration:

No. 1. Upon this plinth we see in the middle a priest, characterized by the sacrificial knife in his right hand and by the cut-off head of the sacrifice in his left. This kind of sacrifice belongs to the Mayas, not to the Nahoas, who, as is well known, offered the heart of the victim; and the whole composition must be interpreted in the light of Maya customs and conceptions. Land tells us that the high priest is the representative of the sun and that his four assistants answer to the four quarters of the horizon. The four assistants occupy here the four corners of the plinth; but in order to fix their orientation we must consult Nahuatl ideas. The north is the place whither the dead go and where the god of death abides, which corresponds best with the assistant in the right lower corner, who appears as a skeleton. It is to be noticed that Death is not commonly represented by an entire carcass, but is incarnate only in arms and legs, or even only in hands and feet. This being settled, the assistant of the lower left-hand corner should be the east, that of the upper right-hand corner the west, and that of the upper left-hand corner the south. The last has also a death's head. Before the bridge of his nose there is a hooked object. The south was also regarded as the place of death and hunger; so that the reference to death is suitable to it. Like the high priest himself, each of the four assistants bears in his hands the head of a victim. These five heads differ from each other and from their bearers by the ornamentation and the anthropological type. We may reasonably infer that these heads represent races hostile to the inhabitants of Santa Lucia, and may correspond to the directions in which their homes lay. In that case this composition would have not merely a ritual but also a political significance. Among the details of the design, the following may be noticed: On the forehead of the high priest there is a crab (*Taschenkrebs*), over his forehead, a symbol whose parallel is not known. Feather tufts (*Federballen*) are braided into the hair, and to it is attached an object reaching nearly to the ground, which looks like the tail end of a serpent. At the back of the wooden girdle there is a representation of a serpent's head looking backward, and in place of the breech clout we see knotted serpents passing round the body, with their heads and tails hanging down. Snakes play a great part in all these compositions. The object upon which the high priest seems to be standing is regarded by Habel as the carcass of the victim. There is certainly something wrapped round it which resembles a breech clout. But there are also three holes which are hard to interpret; and since the lower contour of the object seems to have been mutilated in the original, we cannot well make out what it is. It will be noticed that to this object, as well as to the sacrificial knife that the high priest holds in his hand, the sign of discourse is attached. Above, in the middle of the plinth, there is a raised disk upon which there is a grate-like figure from which depends a hook. As already remarked, no interpretation of this sign is forthcoming; and the same may be said of the shape under the foot of the upper right-hand assistant. It is wrapped up and tied, and an arrow seems to protrude from it.

The plinth just described agrees with the other seven in size alone. Those seven all represent the same performance, namely, the invocation of different divinities.

No. 2. The divinity, who hangs from a serpent's jaw, is surrounded with flames. From its rich necklace is suspended the disk of the sun, also surrounded with flames. Its fingers have claw tips. It is the divinity of the sun, conceived in view of its destructive effects in the tropical coast regions. The hand of the priest's raised arm is covered with a human mask. On the back of the feather mantle which falls behind can be seen, close to the priest's wrist, a human head with hair bound together in a tuft. Noteworthy are the crescent-shaped incisions on the knee of the left leg. Whether mere wrinkles of the skin are intended is questionable. This plinth is the only one into which, beside the priest, a second smaller figure is introduced, which probably has merely a symbolic significance. It is another human skeleton. Death, which, however, like the priest, wears the wooden girdle. Its left arm reaches down and its hand is covered with a mask in the form of a snake's head, while the right arm is stretched up. From the mouth of the skeleton to that of the priest extends a snake-like sign of discourse, though not curved, but of broken form. It very likely merely expresses the close connection of the symbolic figure with the priest.

Whether the furrowed, pointed, elongated form which, starting from the priest's nose, arches backward, is equivalent to the flame-like shape which in other compositions shoots out from the girdle, must remain an open question. Over the head of the priest are two disks with raised rims, upon each of which is figured the head of a dog or some beast. According to the Mexican emblems, this would read "two dogs," which is a date, but may also be a name. Near these disks and over the skeleton we see a stand on which is placed the cut-off head of a victim, the type of which, except for a different earring, agrees exactly with that of the victim carried by the lower left-hand assistant in No. 1.

No. 3. This great and finely worked piece was called an altar by Habel; but Seler more correctly designates it as a fire basin. The whole represents a crouching ape carrying on his back the basin wrapped round with a feather cloth (Federtuch), while he seems to hold Death between his fore paws. Such, at least, is the meaning of the symbolic low relief. It was chiefly this figure of Death which induced Habel to regard the whole as a sacrificial stone, and to assume that the blood of the victim was collected in the shallow basin, without making clear how the victim was to be put to death. Other representations show that the head of the victim was cut off, in order to offer to the divinity the most important part of the man. But with such a mode of death there would scarcely be occasion for so colossal a basin. We know, however, that upon the platforms of the temples there stood great fire basins in which fire had to be kept up day and night. Now this piece would serve such a purpose very well; and consequently Seler's interpretation is to be preferred. The symbolic elements, which in the form and ornamentation of this piece appear as an ape and as Death, bear no direct relation to such a purpose; but they may have had some ritual significance, indicating, for example, the divinity to which the particular temple was dedicated. The ape and Death, alike in the myths of the Mayas and of the Nahoas, are closely connected, representing, perhaps, the opposition of life and death, or that of motion and stillness. Among both peoples we find these among the twenty day signs.

The material described is small in number, but in scientific interest it is an important enrichment to the still limited exhibit of our museum in old American civilization. The sculptures of Santa Lucia are, at any rate, well adapted to bring wider recognition to a proposition long established in science that America, before it was plundered, was in part inhabited by peoples well entitled to be called civilized. It must be remembered that every people follows its own course of development, and that the forms of expression of the resulting civilization are not only the product of the peculiar genius of the race, but are also influenced in the most diverse ways by the conditions of life and the events of history. Science undertakes the task of exploring the conditions of these phenomena, so that, having arrived at a complete understanding of the nature of a civilization and its significance for the people studied, it may attain the only correct standard for its appreciation. In the present case science has not reached that degree of knowledge. Only here and there can it lift the veil which peculiar thoughts and ideas have woven around the productions of the Santa Lucia civilization. Yet even these few glimpses suffice to enable us to say that we have here to do with performances which rise far above the common level. Both conception and execution testify to extraordinary endowments, especially when we reflect that a material as hard as stone allows expression to the idea only after immense technical difficulties have been overcome. All those races, so far as we know, lacked the chief means that we possess, since the use of iron was unknown, and consequently the working of the stone in such fashion as we here see it worked must have been a fearfully wearisome and prolonged labor.

SOME RECENT ADVANCES IN GENERAL GEOLOGY.

Among the recent researches on organic remains none are of greater geological interest and importance than those relating to the Radiolaria. The tiny siliceous structures which belong to this order of Protozoa have long been recognized in our formations, but the part they have played in building up portions of the stony structure of the earth has not until lately been realized. The most striking evidence was that brought forward by Prof. Edgeworth David and Mr. E. F. Pittman (Quart. Journ. Geol. Soc., Vol. lv., p. 16, 1899). They describe a great series of siliceous limestones, jaspers and claystones, with interstratified coral limestones and plant-beds, and submarine tuffs, the whole attaining a thickness of over 9,000 feet, and extending over many hundred square miles in New South Wales. In the bulk of these rocks Radiolaria are present at the rate of about one million to the cubic inch, and among the forms Dr. G. J. Hinde has recognized twenty-nine genera and fifty-three species. Taken as a whole, the deposits are fine-grained, and bear evidence of having been laid down in clear sea water, beyond reach of any but the finest sediment. They do not indicate any very considerable depth of water; but they tell of a vast lapse of time, and of conditions which prevented the dispersal over the area of coarse detritus. What exactly were these conditions it remains for future research to discover. In this country, in Devonshire and Cornwall, the occurrence of radiolarian cherts, both of Ordovician and Carboniferous ages, has been made known through the observations of Dr. Hinde. Mr. Howard Fox and Mr. Teall. The more prominent of these rocks are found in the Lower Carboniferous formation of Coddon Hill, near Barnstaple, where the chert-beds have long been known, although their organic origin was not until recently discovered. The freedom of the beds from mechanically-formed detritus has led to the supposition that these strata were deposited in deep water and at some distance from the coast, although the associated strata above and below the chert-beds do not lend support to the hypothesis. The fact is that at the present time the only extensive

radiolarian deposits known to be in process of accumulation are in the deeper oceanic regions.

Radiolaria, while entirely marine, are widely distributed, and they can exist at various depths in deep and shallow seas. It may be surmised, therefore, that in shallower areas coral-reefs may have acted as barriers to the dispersal of terrestrial debris. Hence in our explanations of the physical conditions of the past we must be guided by the general characters of the sedimentary strata in which bands and beds of radiolarian chert occur, rather than by the evidence of the chert itself. There is, however, little doubt, from the wide distribution of these lowly forms of life, that they may prove of considerable importance in the identification of horizons, although, as might be expected from their present geographical and bathymetrical ranges, some specific types have been of long geological duration.

In the coast ranges in California, and again in Borneo, such radiolarian rocks of Jurassic, or possibly Lower Cretaceous age occur, and it is noteworthy that Dr. Rüst has remarked that "the differences in the Radiolaria from these two rock-divisions are not very striking." (See Hinde's "Description of Fossil Radiolaria from Central Borneo," 1899.)

The question whether the Wealden strata, which are essentially fresh-water, should be grouped as Jurassic rather than Cretaceous has been raised by geologists in the New as well as in the Old World, who have argued that the Wealden plants, fishes and reptiles are Jurassic rather than Cretaceous in character. There has never been any question in this country that the Purbeck and Wealden Beds are intimately connected, both stratigraphically and paleontologically, and it has been held by some geologists that locally the Wealden Beds and Lower Greensand bear also evidence of continuous deposition. The subject was lately discussed by Mr. G. W. Lamplugh (Brit. Assoc., Bradford, 1900), who points out that in Dorset, Hampshire and Surrey there is evidence of the close stratigraphical connection between Wealden and Lower Greensand, that part of the fresh-water Wealden must represent true marine Lower Cretaceous beds elsewhere, and that consequently it is equally erroneous to classify the Wealden series entirely with the Jurassic system or entirely with the Cretaceous.

If the planes of division between our formations are more often than not ill-defined, so also are those between the main systems. Between our Palaeozoic and Mesozoic strata there has never been a very well-marked boundary, for some authorities have placed the Permian with the older division and some with the newer.

The tendency of recent investigations in the midland areas is to show that a considerable series of red beds which have been regarded as Permian are truly portions of the coal-measures, while it is evident that the magnesian limestone series is stratigraphically united more closely with the Triassic strata. In Britain the main mass of the Permian (magnesian limestone series, etc.) lies unquestionably with great discordance on various subdivisions of the denuded carboniferous and Devonian rocks. Abroad in many areas, in India, Australia and elsewhere, there appear connecting links in strata grouped as permian-carboniferous; but it is a question whether the original Permian is anything more than a provincial set of strata, unentitled to rank with a system (see C. R. Keyes, Journ. Geol., Chicago, Vol. vii., p. 337, 1899).

As the history of the successive strata in different countries becomes better understood, so it becomes possible more closely to parallel the life-epochs which are represented in the rocks. Such life-epochs do not, of course, correspond with the sedimentary changes which are recorded by the rocks themselves, and hence a double system of grouping becomes needful. In our own country this has been long apparent, and the successive groups of strata which are so well established in the Ordovician and Silurian systems of Wales and the lake district and the southern uplands of Scotland, require distinct stratigraphical terms, while the life-history and the correlation of the subdivisions are indicated by the zonal groupings based on zoological evidence. The representation on maps and in sections of the main stratigraphical groups, or geological formations, is essential in order to show the physical structure of a country, not only in reference to economic questions, but also in regard to the influence on the present scenery of the rocks and the movements to which they have been subjected. Different types of landscape and the evolution of river systems are engaging a good deal of attention, notably in the United States; and the study has led to the introduction of a large number of terms which are rather difficult to remember, but the more important are explained in Mr. J. E. Marr's "Scientific Study of Scenery."

Increasing attention is given to the great movements which have affected the rocks, especially in mountain regions. The pioneering work of Helm in Alpine regions has been utilized and developed in the most brilliant manner by Lapworth and Rothpletz and many others. The old ideas of reversed faults have been, so to speak, magnified into great earth movements, whereby huge masses of country have been overfolded, fractured, and overthrust, the older being pushed over the newer. On a small scale such overthrusts were long ago recognized in some coal-fields by the name of overlap faults, and the displacement was measured by yards—now it is sometimes reckoned by miles. Moreover, not only in Highland regions, where the secret inferred by Nicol was unraveled by Lapworth, have these mighty overthrusts been made manifest, but on a comparatively small but by no means unimportant scale they have been traced out and pictured in the Cretaceous rocks of the Isle of Purbeck by Mr. A. Strahan. The same observer has drawn attention to other overthrusts in the great coal-field of South Wales.

All sorts of complicated structures due to cross-folding and faulting, to successive horizontal displacements and twisting, have been produced in mountain regions; and Dr. Ogilvie Gordon has dealt exhaustively with the subject in a paper on the torsion-structure of the Dolomites (Quart. Journ. Geol. Soc., Vol. lv., p. 569). To quote one sentence from her paper will, perhaps, be enough to give an idea of

the puzzles she has attempted to solve: "Anticlines have been twisted round synclines, and the rocks in the synclines have themselves been twisted and distorted, buckled up and depressed, overthrust and faulted normally, cross-faulted and cleaved, to an extent that has not hitherto been realized." We may add that the subject of torsion-structure has been examined mathematically by Mr. J. Buchanan (Phil. Mag., Vol. I., p. 261).

The evidence of great folds and flexures, accompanied by overthrust faults, has lately been brought more fully to light in the Malvern region by Prof. T. T. Groom, while in the lake district the field labors of Mr. J. E. Marr and Mr. A. Harker, as recently expounded (Proc. Geol. Assoc., Vol. xvi., August, 1900), indicate that the country has there been affected, not only by overthrust faulting, but by more or less horizontal displacement, termed "lag" faults, whereby lower and older strata have been moved more rapidly than newer overlying strata, which consequently have lagged behind. Other faults, called "tears," are described, where, during these movements, rents have occurred in the shifting masses of strata without occasioning much vertical displacement.

In very many cases along fault-planes there has been produced a kind of breccia due to the effects of displacement, but more striking results of such action have lately been made known in the production of conglomerates. In such cases the effects of earth-movements have not only fractured, but actually worn away the edges of the shattered rocks. In the Isle of Man, where the Manx slates have undergone acute folding followed by intense shearing, the shear-cleavage has cut and displaced bands of grit and has actually rounded the fragments so as to produce what Mr. Lamplugh has termed a crush-conglomerate. His observations have borne good fruit elsewhere. Mr. C. A. Matley has described crush-breccias and crush-conglomerates in Anglesey, where they occur "along zones of powerful crushing, especially in areas where the soft, fine-grained, slaty rocks alternate with tougher and more brittle strata, such as grits and quartzites" (Quart. Journ. Geol. Soc., Vol. lv., p. 657), and Prof. Groom has dealt with the crush-breccias of the Malvern Range (ibid., p. 151).

It has long been felt that some revolution in palaeontological nomenclature is needed, and, fortunately, the matter has been taken up boldly and effectively by Dr. Arthur W. Rowe (Quart. Journ. Geol. Soc., Vol. lv., p. 494). In old times new species were named from fossils obtained from formations without reference to their special horizons. Some were founded on the evidence of but one or two specimens, and it has not unfrequently happened that "varieties" have been found which preceded in time the type species. Of late years, when increasing attention has been given to careful collecting, there has been a tendency to "make every prominent form a species, on the plea that every minute variation must be ticketed and pigeon-holed." In this way very many of the old landmarks have been removed, the study and identification of species have passed beyond the comprehension of any but the specialist, and the value of his labors to others has been more and more reduced or obscured. Dr. Rowe has now for some years devoted the leisure of a busy life to a careful collection of Micrasters from successive stages or zones in the middle and upper chalk. He finds that by examining the facies of the genus in each horizon, passage-forms prove to be the rule, while sharply-defined and typical species are the exception. He has been able to trace an unbroken continuity in the evolution of Micraster, so that in successive stages of the chalk he finds variations in the structure of the tests, variations, indeed, which "are so marked that one can tell by their aid from what zone a Micraster is derived." As passage-forms and mutations form the bulk of the genus, it is necessary to mass certain obviously allied forms into groups which will admit of the zoological continuity being exemplified and the zonal peculiarities noted. This is the plan adopted by Dr. Rowe, and it certainly appears most philosophical to take a series of specimens rather than an individual as the foundation for a zonal specific type; and to group rather than to try and separate so many forms. It is satisfactory to learn that the detailed zoological work carried out by Dr. Rowe bears witness to the great value of the palaeontological zones which were broadly marked out in the chalk of this country nearly twenty-five years ago by Dr. Charles Barrois.

There is no doubt that the careful collecting of fossils from definite horizons, and from horizons in definite sequence, is of the utmost importance in advancing palaeontological knowledge. Such work, as a rule, requires prolonged labor, otherwise the conclusions are worse than useless. Now, by close research, it is possible to trace out the successive modifications that occur in stratigraphic sequence, and this has been attempted with the Graptolites, and with several groups of Mollusca and Brachiopoda, as well as with Echinodermata. Even in so variable a group as the oysters, it is affirmed by Messrs. R. T. Hill and T. W. Vaughan (Bulletin U. S. Geol. Survey, No. 151) that these organic remains possess very distinct specific characters, have definite geologic horizons and are of the greatest value in stratigraphic work. Their value, moreover, may be not merely scientific, but also of some benefit to humanity. Instances have occurred in Texas where, by the aid of these fossils, brought up from great depths in diamond-drill cores, cities upon the point of abandoning the attempt to procure artesian water have been warranted in drilling a few feet farther, and with success.

Views on the duration of geological time have occupied a considerable amount of letterpress during the past fifty years, and during the past few years the subject has been discussed by Mr. G. K. Gilbert, Mr. J. G. Goodchild, Sir A. Geikie, Prof. J. Joly, and Prof. W. J. Sollas.

Mr. Gilbert would look to the influence of pre-cessional changes and to the periodic modification of the climatic conditions of the two hemispheres. Contrasted phases of climate would thus occur every 10,500 years, and such changes should be looked for in the strata. Indications of moist or dry climates, of the increase or decrease of glaciers, and of the local fluctuations of sea-level as affecting the character and

extent of strata are the indices to which he would appeal.

Prof. Joly, arguing from the amount of sodium at present contained in the waters of the ocean and the amount annually supplied by rivers, claims that a period of between eighty and ninety millions of years has elapsed since the land first became exposed to denuding agencies. Sodium, as stated by Prof. Joly, is the only dissolved substance of which the ocean has retained substantially the whole amount committed to it by the solvent denudation of geological time.

Prof. Eug. Dubois, dealing with the circulation of carbonate of lime, believes that the real lapse of time since the formation of a solid crust and the appearance of life upon the globe may be more than one thousand million years.

Mr. J. G. Goodchild in 1897 also argued that the more trustworthy data relating to the time of formation of marine strata were furnished by deposits of organo-chemical origin. He concluded that over seven hundred million years would be required since the commencement of the Cambrian period.

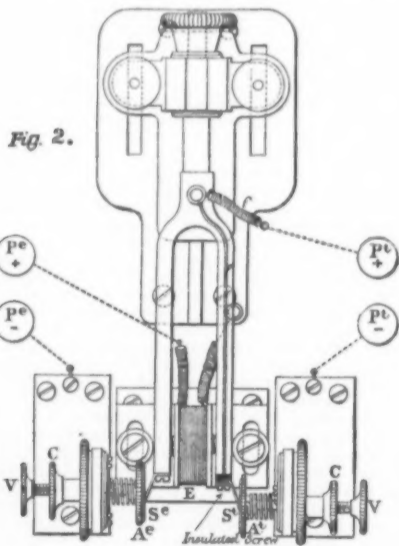
Although the conclusions arrived at by investigators are widely at variance, it is not improbable that some trustworthy data may in time be gained by the different methods of research advocated by Gilbert and by Joly. As lately remarked by Sir A. Geikie, progress in geology will be best made by the adoption of more precise methods of research and by a hearty co-operation among geologists in all parts of the world; and Prof. Sollas well observed in his address at Bradford that "our science has become evolutionary, and in the transformation has grown more comprehensive." The work of the paleontologist must be supported by very detailed local fieldwork, work which at present is very much in its infancy. Such work will help in the grand story of "the science of the earth," a story whose materials can only be gathered together by the patient local toiler; while he or she may well be content to see the results worked up by those who by training and opportunity are able to take a comprehensive view of the earth as a whole.—H. B. W., in Nature.

THE MERCADIER MULTIPLE TELEGRAPH.

PARAGRAPHS of a more or less well informed character have recently been appearing in the daily press with regard to experiments with a "twelve-message wire." The system to which reference has been made is the "Mercadier system of multiple, reversible or multiplex telegraphy." The system dates back to some period prior to 1873, but has only taken practical shape during recent years. It has been tried with some success between Paris and Dijon, Paris and Toulouse; and in February, 1898, experiments of a highly satisfactory nature took place between Paris and Bordeaux. During last month the system was tried in England, the trials taking place on a copper line between London and Glasgow. Opinions vary as to the success of these latter trials, which have now been temporarily suspended while some repairs are being executed in the apparatus. Immediately on completion of these repairs, the experiments will be resumed.

The inventor, Mons. M. E. Mercadier, is a professor at the High School of the French Post and Telegraph Department, and a director of the Polytechnic School at Paris.

The system is a syntonic one. A Morse key (*m n*, Fig. 1) is used for sending. This key is placed in the secondary circuit of an induction coil, *T*. The primary circuit of this coil is interrupted by an electro-diapason, or tuning-fork, which is kept in constant vibration by means of an electric attachment shown in more detail



In Fig. 2. In this figure it will be seen that an electromagnet, *E*, is placed between the arms of the fork, and is connected on one side with the battery, *Pc*, and on the other side with the metal of the fork. The fork terminates at one extremity in a steel point, *Se*, which faces a platinum contact, *Ae*, connected with the other pole of the battery. We thus get an ordinary contact-breaking arrangement, which keeps the tuning-fork in constant motion. The other arm of the fork, which is, of course, vibrating at the same rate, terminates also in a steel point, *St*. This second point is isolated from the metal of the fork by means of a small ivory block, and is connected with an insulated aluminium wire (*f*, Fig. 2), and thence with the positive pole of a second battery, *Pt*. The negative pole of this battery

is connected with a platinum contact, *At*, by means of one of the wires, *1*, of the coil, *T* (Fig. 1). It will be seen that the movement of the fork will throw a succession of currents into the primary coil of *T*, and induce an equal number of currents in the secondary coil, in the circuit of which is placed the sending key. The inventor has christened his transmitting instrument an "inductophone."

On the left-hand side of Fig. 1 is shown a simplified inductophone, which can be used successfully on fairly long lines. In this form only one battery is used, and the electromagnet, *E*, and the primary coil are joined in parallel. If the resistances of the electromagnet and the primary coil are about equal, this arrangement will work well, and has the advantage of greater simplicity.

In Fig. 1 three inductophones only are shown. In

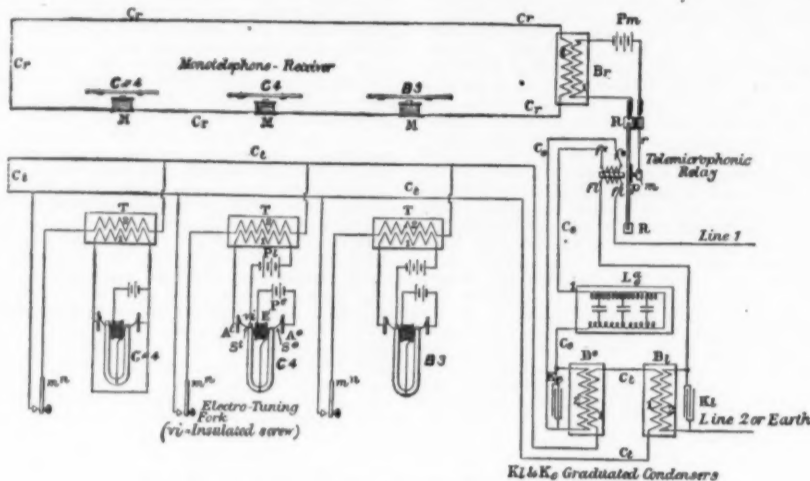
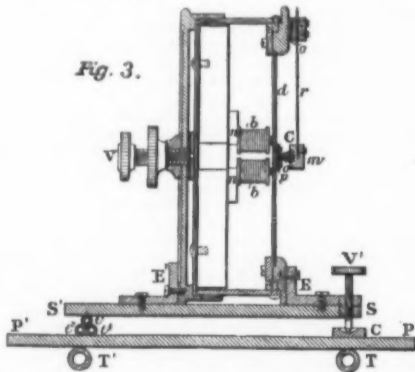


FIG. 1.—THE MERCADIER MULTIPLE TELEGRAPH.

actual practice twelve are used for transmitting (see Fig. 5). The secondary wires of the transformers, *T* (Fig. 1), are connected in parallel to the transmitting circuit, *Ct*. The depression of one of the keys, *m n* (Fig. 1), causes a rhythmic intermittent current to be set up in the transmitting circuit, and as a consequence in the primary coils of the induction coils, *Be* and *Bt* (Fig. 1). In consequence of the sparking of the points, *St* or *Se*, and the contacts, *At* or *Ae*, the transmitting circuit is never completely interrupted, and the current is rather an oscillating than an intermittent one. The period of the induced current is, of course, equal to the period of the tuning-fork. The tuning-forks have each a different pitch, the difference being of at least a semi-tone. In accordance with the law of the co-existence of small oscillations, the currents from each inductophone can be superimposed in the transmitting circuit without confusion. Passing through the primaries of the coils, *Be* and *Bt*, they induce in the secondaries a series of currents of like period, which pass by means of the two wires, *fe* and *ft*, of the receiving relay, *Rd*, into the real line and the artificial line.

In order to follow the further progress of the current, it will be necessary to describe the receiving arrangements. The receiver consists of a differential microphonic relay (Fig. 3), and a series of syntonized "mono-telephones." The relay is formed of a telephone, of which *d* is the diaphragm and *n* is the core of the electromagnet. The magnet is wound with two identical wires (*ft* and *fe*, Fig. 1), through which currents coming from a single source can pass in opposite directions. Attached to this telephone is a microphone formed of a carbon plate, *p* (Fig. 3), screwed to the diaphragm, and a carbon block, *c*, fixed in a metal mount, *m*, and supported by a weak flat spring, *r*. The spring of the microphone is fixed to the frame of the telephone, and isolated by means of an ebonite plate,



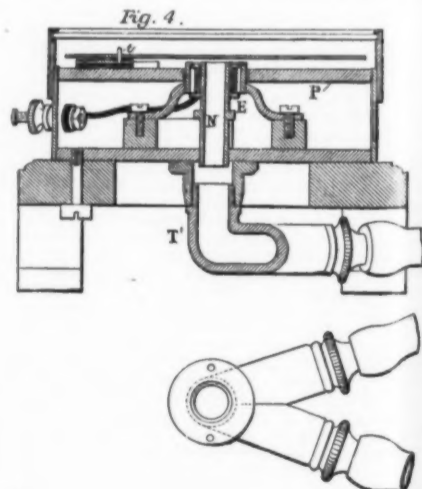
THE MERCADIER MULTIPLE TELEGRAPH.

o. *V* is a screw for the purpose of adjusting the distance of the electromagnet from the diaphragm. This apparatus is supported on its base by means of two shoulders, *EE'*. The base, *SS'*, carries a rubber tube, *r'*, fixed to its under side, and this tube rests upon two other rubber tubes, *PP'*, which are fixed to the platform, *PP'*. This platform also rests upon two stout rubber tubes, *TT'*, the object being to insulate the relay from all external vibration. A screw, *V'*, will raise or lower one side of the base, *SS'*, the system of tubes, *PP'*, acting as a hinge. By this means the sensitiveness of the microphone can be adjusted.

Fig. 1 shows the relation of the relay to the other parts of the apparatus. *Pm* is the microphone battery, which is connected by one pole to the spring of the

microphone, and by the other to the primary coil of an induction coil, *Br*. The secondary coil of *Br* forms part of the receiving circuit, *Cr*, in which the mono-telephones are joined in series. The installation is completed by two graduated condensers, *K1* and *K2*, joined in parallel; the one across the line coil, *Bt*, and the other across the coil of the artificial line, *Be*.

Before proceeding to describe the course of the signals, we will briefly describe the "mono-telephones" used in the receiving circuit. The inventor has employed the word "mono-telephone" because the instruments are adjusted to respond to one sound only, and to remain deaf to all others. In a cylindrical glass-covered box is inclosed a powerful electromagnet, of which *N* is the core (Fig. 4). This core is hollow, and is inclosed in a coil, *E*, in the usual way. The diaphragm is not clamped at its whole circumference, and



An operator at *A* sends Morse signals on the key, *m n* of the inductophone, *Bt*. These signals induce signals of a like character in the secondaries of the coils, *Bt* and *Bt*. Those in *Bt* go to line through the wires, *ft*, of the relay, *Rd*, but their effect on the relay is neutralized by the effect of the signals passing simultaneously but in the opposite direction by the wires *fe*, and coming from the coil, *Be*, by way of the artificial line, *Le*. In order that the extinction of the effect on the relay should be perfect, the resistance and capacity of the artificial line must be accurately adjusted; and for this purpose graduated rheostats and condensers are introduced. It is thus possible to give the same phase to the signals arriving by *fe* and *ft*, and the extinction of the effect on the relay is perfect.

plete. The relay, then, remains without movement, and the signals go to line and reach the remote station, B. Entering the secondary coil of *B1*, they pass by the wire, *f1*, of the relay, *Rd*, of station, B. As they are not here neutralized by any current in *fe*, the signals are communicated by the diaphragm of the relay to the microphonic contact, *pm*. The microphone communicates the signals to the primary of the coil, *Br*, and they are reproduced by induction in the secondary, and thus in the receiving circuit, *Cr*. But the mono-telephone, *B*, is the only one which responds, because its diaphragm is the only one capable of responding to the signals sent out by the inductophone, *B*, of the transmitting station, A. At the same time, the operators at all the other keys can be sending out signals which will be responded to by their respective mono-telephones at the receiving station, the signals remaining quite distinct. Assuming twelve inductophones and twelve mono-telephones to be working at each station, we can thus reach a total of twenty-four simultaneous transmissions. Fig. 5 shows a complete set, as employed in the Paris-Bordeaux experiments.

From the above brief review of the main points of this system, it will be possible to understand the principle of the new apparatus. It is impossible here to enter into the details as to the ingenious means adopted by the inventor to adapt his system to the requirements of practical telegraphy. The annoyance of the sound from so many buzzing instruments has been overcome by placing all the sound-producing appliances in a padded cupboard. Means have been found for using it upon wires serving several stations in echelon, and for applying an acoustic call by which the attention of any desired station can be attracted.

One of the chief advantages claimed for the system

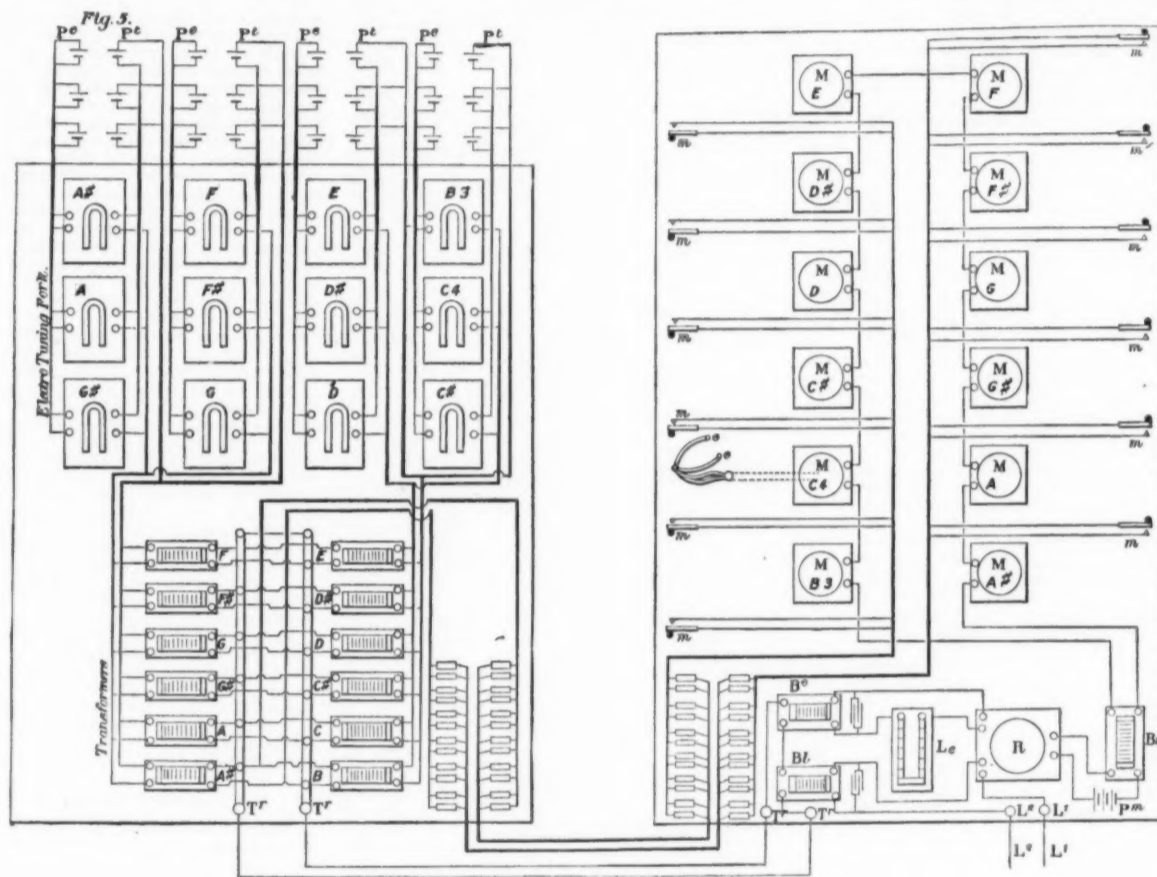
'All general statements are false, and probably this one is also;' so what I am saying about the courage to attack anything that comes along will naturally work within reasonable human limits, knowing that probably there is not one Newton or one Napoleon among you. But my point is that more men fail from timidity than from too much courage. But do not imagine that courage does not see the dangers of the enterprise; that would be mere stupidity or blind conceit. I have a friend who has risen fast, and now, while still young, he is the president of a great railroad. He said to me the other day, 'I never yet undertook a big job without being scared.'

"It has come in my way to know a good deal about the entrance of young engineers into railroad life. I have talked much of this with railroad men, and have had some experience of my own. The sum of the testimony is that engineering schools are the best recruiting ground for railroad officers. But it is pretty well agreed that when the young men come out of these schools they cannot draw, they cannot use their mathematics, they cannot write an acceptable English document. Here, again, we are speaking in general terms, but probably we are not far wrong. Of the drawing it is too late to talk now. If you are not good draughtsmen it is not likely that you ever will be. Of the mathematics I may, perhaps, say a useful word. It is not a question of higher mathematics, but of the everyday bread-and-butter mathematics. This is where the young graduate is deficient, and where he can quickly supply his deficiencies. For example, not long ago I asked a young man who had graduated with distinction at one of our best engineering schools to convert kilogrammes per square millimeter into pounds per square inch. It was a case of

smoking. If, then, you wish to master a good English style, read good English. Read little of it, but read it thoroughly and constantly, and never read anything else. Do not read the daily newspapers further than to get the sort of information that every intelligent citizen ought to have.

"You are permitted to enter on your work at the beginning of one of the greatest epochs in the history of our country. During your active lives our population will be doubled. That will mean more consumers, more producers and more competition. These opportunities will be multiplied and so will the men who do the work. We shall become the greatest manufacturing nation, the greatest carriers of ocean commerce and the greatest shipbuilders. In all of this the engineer must supply technical knowledge. His work will not be as picturesque as in the past, but there will be more of it and it will be of even greater importance to society. But, further, the engineer will invade the field of administration. He will gradually take the executive offices in the railroads and in the great industrial corporations. For this there are several reasons.

"First, the day of the scientific man has come and the engineer will go to the front because of his technical acquirements. Second, his education and his experience develop those intellectual qualities which are required in handling great affairs, namely, observation, analysis and reason. But third, and most important, his education and experience will have developed the highest moral qualities. The engineer does not regard himself as a moral leader, probably he never thinks of that part of his work. But he is, and he must be, a moral leader, for his whole teaching and experience lead straight to absolute honesty of



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is the economy of wires. As a set-off to this, it is necessary to take into consideration the possibilities of dislocation which exists when reliance is placed on a very small number of wires. The system being based upon the use of rapid oscillatory currents, it is, of course, possible to use the wire simultaneously for any ordinary telegraph system with continuous currents. The invention is also applicable to the transmission of spoken sounds, and thus opens up a possibility of duplex telephony. Finally, the possible number of transmitters and receivers is not limited to twelve, and can without serious difficulty be augmented. With twelve transmitters it is said to be capable of a total output of from 600 to 700 messages per hour.—Engineering.

THE FUTURE OF ENGINEERING.

An address to the students was delivered by Col. Henry G. Prout at the Rensselaer Polytechnic Institute, in which he said:

"Your first lesson will probably be in measuring your own strength with that of other men. A good deal of this you have had in college, but now it comes in a different way. Heretofore the struggle has been to meet conditions already laid down. Now the field of your efforts is bounded only by your own abilities, and if I were to specify one quality more important than any other in the work now before you, it is courage. The gods are always kind to a brave man. We have assumed so far that at this institution you have learned the principles of your art. Beyond that we are justified in assuming that you have trained your powers of observation of analysis and of reason. You have now to ascertain and to prove that you have the courage to use your weapons. I should say that one of the great lessons of human experience is never to admit, to yourself or to others, that you cannot do the job that you see before you. Voltaire said,

some tensile tests. After a good deal of labor he presented to me the astonishing conclusion that the specimens had broken under a strain of 0.221468 pound per square inch. You will observe that the precision was very great, but that the error was greater. Probably he had not come within 79 or 80 thousand pounds of the truth. I should advise you to begin at once to learn the short cuts in computation, and also to learn to use your sense as to the accuracy required in each operation, or possible in each operation. You must often have heard of the young engineer who paced the diameter of a circle and then multiplied the diameter by pi carried to fourteen places of decimals to get the circumference. I have actually known an engineer to design a section of a rail with such precision that he expressed the width of the foot of that rail in six places of decimals.

"I have spoken of the defective English training with which the young engineer is apt to start. This is a good deal more important than you are likely to suppose, and it is easier to correct. But first let me warn you against mere fluency in writing or in speaking. That is likely to produce bad English and not good English. You will remember Carlyle's saying about the English, that of all the people on the earth they are the stupidest in speech and the wisest in action. The harm done and the fatigue inflicted by fluency are such that I have often thought that it would be a blessed thing for humanity if we were all struck dumb for a year.

"But a clear, simple, accurate and, if possible, distinguished English style is a precious possession to the young engineer, and it is within the reach of nine men out of ten. It will come from so saturating your minds with good English that bad English is offensive. It is a mere matter of taste, and there is no such thing as acquiring taste by rule. You might as well expect to become a judge of tobacco by talking about

thought and purpose. If he is not fundamentally honest in his thought and conduct nature finds it out and his dam goes out, or his bridge falls, or his machine fails. He cannot be a sophist and an engineer at the same time, nature does not permit it. I remember seeing the matter stated by Macaulay somewhat in this way: 'The man who reasons for some actual end in practice must be accurate. For disputation he needs no correct premises and only so much logic that he will not be caught.'

"Fortunately it happens that directly in proportion to the zeal and fidelity with which you serve the profession will be your fame and influence in that profession, and in such proportion will be the riches and the glory that will come to you. This, again, is a general proposition, certain to fail in many cases but true in a large way.

"And how are you to serve that profession? There is no special recipe; the only way is by being brave and honest gentlemen and by using with diligence such faculties as the Lord has given to you. I will give you one bit of experience which may be of a little use some time. About once in so often someone says that the engineers ought to adopt a code of ethics. He thinks a formal code would keep one engineer from stealing another engineer's job, or his glory, or something else that is his. My argument is that a code would bind the conscientious man and would not bind the rogish man or the man of coarse perceptions; the Ten Commandments, the common law and usages of decent society are code enough for any man in any profession. I venture the proposition that the codes of the medical associations have done great harm to society by the protection that they have thrown around incompetent physicians, and they have hurt the profession more than they have helped it.

"I judge that in the next ten years or so the social use of the professional man will be far greater than

It has even been in the past. To him society must turn for help in the great new problems raised by the combinations of capital and labor. It is not likely that the law will find a way to stop these combinations; it is doubtful if it is advisable that they should be stopped; but they must be directed and perhaps controlled in some degree.

"The business man measures his success by the money profit that he makes. He may or he may not have produced a beautiful article or a useful article; he may or he may not have added to the health or the happiness of the group of people just around him. These considerations are secondary; the primary considerations are dividends. Mind, I am not expressing an opinion or criticizing motives; I am stating a fact. On the other hand, the primary consideration with the professional man must be the interest of his client, whether that client be a man or a city or state. He can think only incidentally of his fees. In fact, much fine professional work—much of the work most useful to the world—is done without any fees or money return whatever. Fortunately for the progress of the human race, man is endowed with a sense of duty, with a thirst for knowledge, with a desire for the approbation of noble minds. So the true professional spirit is evolved, and this spirit must save the railroads and the great industrial corporations from some of the disasters which arrogance and ignorance are provoking."

AMERICAN LOCOMOTIVES IN ENGLAND.—II.

By A LOCOMOTIVE ENGINEER.

In my former article I dealt with the untenable character of Mr. Rous-Marten's main contention in defense of the American engines on the Midland Railway. Seeing how faulty his main contention is, it is, perhaps, scarcely worth while to go into the one or two details touched upon by him. But for the benefit of the non-technical press, it may be pointed out that the fact that the piston stroke of the American engines is shorter by 2 inches than that of their British competitors, to which Mr. Rous-Marten called attention, as placing the former at some disadvantage, is of no importance in this instance as regards the consumption of steam—and consequent coal consumption—as all experienced locomotive men well know. The remarkable variability of the valve gear of a locomotive enables a driver so to regulate the cut-off that the quantity of steam entering the cylinders at each stroke is at once adjusted to the required tractive effort. The shorter stroke of the American engines doubtless necessitates a proportionately higher average steam pressure in the cylinders as compared with that in the British engines—the diameter of cylinders and driving wheels being, I understand, the same in both makes of engines—and, as a consequence, the density of the steam passing through the cylinders of the American engines will be proportionately greater than that passing through the cylinders of the British engines. But this greater density is, or ought to be, balanced, as far as consumption of steam is concerned, within a very inappreciable fraction, if not wholly, by the less bulk of the steam used at each revolution of the driving wheels by reason of the less cylinder capacity of the American engines in proportion to their 2-inch shorter piston stroke.

That the weight of steam which passes through the cylinders of the American engines is greater, from some cause or other, than that passing through those of the British engines I am not questioning. On the contrary, I have no doubt the high consumption of fuel by the American engines is to be accounted for, in part at all events, in some such way—a point which I shall enlarge upon later on. What I am now merely contending for is that the shorter piston stroke of the American engines does not in itself place them at a disadvantage.

As regards the matter of boiler pressure, to which Mr. Rous-Marten referred, both engines were worked at the same pressure, namely, 160 pounds to the square inch, which, I believe, is the standard maximum on the Midland Railway, and one fails to see why this should be regarded as otherwise than perfectly fair to the American engines, even supposing their safety valves to have been originally set to 180 pounds, provided their cylinder power is sufficient to enable them to haul the prescribed load satisfactorily over the steepest portions of the journey. That there is no question about the American engines having had ample tractive power for the test load, even with 160 pounds boiler pressure, is evident from Mr. Johnson's statement that "the foreign engines worked their trains satisfactorily." One is almost ashamed to have to discuss such elementary questions in a technical journal, but Mr. Rous-Marten's references to them seem to leave me no alternative.

These two points—boiler pressure and length of piston stroke—complete what I may call the "matters of fact" touched upon by Mr. Rous-Marten in dealing with the Midland Railway trials. I shall, therefore, proceed to a consideration of the various questions which naturally present themselves for solution in connection with these trials, including, among other matters, what I may describe as the "engine-off-the-peg" remarks made by the chairman of the Midland Railway to the representative of the Daily Mail in reference to American engines in general, to which Mr. Rous-Marten makes allusion in the concluding part of his article.

As far as the facts established by the trials go, the first question which naturally occurs to me is: Why should the American engines consume from 20 to 25 per cent more fuel than their British competitors in doing the same work? I must candidly confess that it is not easy to give a conclusive answer, in this instance at all events, although as regards the fact that American engines do use more fuel than English engines, even when doing the same work, it may be said that the experience on the Midland Railway only confirms what has been the almost universal experience wherever American and British engines have been pitted against one another on common ground and under like conditions of working. The only special feature about the Midland Railway case is that the trials appear to have been conducted more systematically, and with, perhaps, greater exactitude as regards the loads drawn and other conditions of

working than usual, while it possesses this notable feature, that the results thus obtained by a railway company of the highest standing have been officially communicated to the world without the restrictions of "confidential" and "for private information only," which so frequently accompany statements in connection with similar trials of English and American locomotives, thereby rendering them quite useless for discussions of this kind. But why there should be this notable higher consumption of fuel by American locomotives is, I would again say, not so readily explicable.

Before going, however, into the "whys and wherefores" of this matter, I would make one remark regarding a point to which allusion is often made in connection with the question of fuel consumption by locomotives, namely, that a notable variation in the quantity of fuel used by different individual engines of the same lot, even when made from the same drawings and by the same makers, is frequently experienced. This undoubtedly is so; but it seldom amounts in the most extreme cases to anything like 25 or 30 per cent; while, on the other hand, the average consumption by one lot of engines of like design and make will be found to agree very closely with the average consumption of fuel by another lot of engines made to the same dimensions by the same makers, when doing the same work. In the Midland Railway trials the question, as I understand it, is not as to the fuel consumption by one particular American engine as compared with one particular British engine, but that the average consumption of fuel by the twenty or thirty American engines used in these trials, made partly by the Baldwin Company and partly by the Schenectady Company, was from 25 to 30 per cent more than the average consumption of fuel by an equal number of engines supplied partly by Scotch and partly by English makers when doing the self-same work. When one comes, however, to explain the reason why, it is not, as I have said before, so simple a matter.

As a result of no inconsiderable acquaintance with the working of both English and American engines, I had been inclined to think that the wastefulness of fuel by the latter was in a measure due to the tendency in American locomotive practice to use blast pipes with more contracted orifices than is the practice in this country for the same size of cylinders and fire grates, so as to insure the engines making "plenty of steam." I had also attributed it in a measure to the American practice of employing boilers of inordinate size, with a like object—a practice which may be all very well if the purpose in view when designing an engine be merely to insure one which shall be capable of taking an occasional abnormally heavy train under exceptionally bad conditions as regards wind and weather, but without any regard to fuel economy by the engine in dealing with normal loads of less weight—a point which I shall more fully touch upon when I come to deal with the "engine-off-the-peg" branch of the subject. In the Midland Railway trials, however, the latter of the two reasons I have named does not seem to apply, as it would appear—from what Mr. Rous-Marten says—that the English and American engines in question have "practically identical dimensions," which, I presume, includes those of the boilers as well as those of the other main parts of the engines. On the other hand, one can hardly suppose that if their greater consumption of fuel was due merely to unnecessarily contracted blast orifices they would have been left unaltered, to the waste of fuel, when the alteration would, one would think, have been so easy to make. We must, therefore, conclude that the cause is to be found in some unfavorable proportions of various minor details in the boilers and the steam-using machinery of the engines—the latter resulting in a greater consumption of steam, and the former in incomplete combustion of the fuel or in the escape of unproductive heat up the chimney, either or both of which means addition to the coal bill. It may be that the consumption of steam by the American engines is greater in consequence of their not running as freely as the British engines, owing to their having smaller wearing surfaces, or it may be due to some want of stiffness in their frame-staying, permitting of cross-straining, and consequent internal frictions, of which the English engines are free; or, finally, it may be due—if I may be pardoned for suggesting it—to more or less of permanent "cross-winding" in the building up of the engines from too hurried a putting of them together under pressure of the very limited time allowed for their construction and delivery.

Mr. Rous-Marten rather implies—although he guards against saying so in words—that the high consumption of fuel by the American engines may have been due to want of skill, or even want of will, on the part of the Midland engine drivers, seeing that he remarks: "I do not touch the question whether the American engines would show as well in the hands of British drivers as when driven by men who have always been accustomed to that type of locomotive. Neither do I touch the question whether British drivers would be anxious to make American engines appear superior to British engines in any such trial." As regards the first suggestion in the foregoing quotation, it strikes one that there must be something "uncanny"—as our countrymen over the border would say—about American locomotives if the skilled drivers on a first-class line like the Midland cannot master the "outs-and-ins" of them sufficiently to qualify them for handling the engines as efficiently as English engines after twelve or fifteen months' use of the former prior to the trial. While, as regards the second suggestion, I would simply say this, that if the makers of the American engines in question have any reason to think that full justice was not done to their engines, and that American drivers could reverse the Midland Railway Company's unfavorable experience of them, the railway authorities would, we may feel sure, be only too pleased to afford them an opportunity of doing so. I have alluded to this because I observe that the American press are already suggesting some such reasons as the foregoing for the unfavorable performance of the American engines in this case.

There is, however, another explanation, I see, being put forward by the American press—at their wits' end, apparently, for a satisfactory reason for the high consumption of fuel by the American engines in the recent trial—and it is this, that as American engines are built for "harder service" than English engines, the loads hauled in these trials were not big enough, and that if the American locomotives had been working up to their full capacity they would have used less fuel "per load hauled"! This, surely, must have been written for consumption by our good friends the "non-technical press" and the "superficial thinker." According to Mr. Rous-Marten, the American engines were over-taxed, not under-loaded, his explanation being that for such loads as were run by the competing engines the American builders would, "in accordance with the rigid American rule," and if left to themselves, have supplied engines "of far greater power." When American locomotive doctors differ, who shall agree? A week or two's further reflection will, doubtless, bring forth in the pro-American press a fresh diagnosis of the case with its appropriately modified prescription.

The next item to be dealt with in connection with the Midland Railway report is that of the extra oil consumption by the American engines. It may not be a very serious one in itself, I mean as regards the actual cost of the oil consumed, although in this country, with the keen competition there is between railway companies, the sum of money which the "50 per cent" extra consumption of oil by the American engines represents at its price in this country is well worth saving. Some writers on the subject have suggested its being due to the American engines having, it may be, 50 per cent more oil holes than their English competitors. If this were so, it would, of course, mean that the former had one extra and useless oil hole for every two useful ones in the English engines, it being evident that the number in the latter, whatever it is, is all-sufficient for the purpose, to judge from the fact that the engines run cool. Besides, it would imply that the Midland drivers had gone on pouring useless oil into useless holes simply because they were there. No, the "superficial thinker" may take my assurance that American locomotive builders do not spend a farthing more than they can help in making oil holes or any other details. The secret is rather to be found in the fact that as a result of the "rigid American rule" of keeping down first cost by what I may call "scrimping" details, the oiling apparatus is not so fully perfected in American engines by the use of oil syphons to secure regular, but at the same time economical "feeding" of the wearing surfaces as in British-made engines. The oil has, therefore, to be poured on at those joints and surfaces where syphons are absent, at convenient opportunities on the journey, in quantities that result in its running more or less to waste. But, besides this, a lack of wearing surface in American engines, as compared with English engines, and the use in some parts of softer materials than are employed by British locomotive builders for corresponding parts, with the consequent need for more copious oiling, may be looked to as accounting for the higher consumption of oil by American engines. Any want of "square" in the building up of the American engines, to which I have already alluded, with its resulting internal strains tending to cause heating of the bearings, would, of course, account for extra oil consumption; but this is a point which can be positively known only by those having the opportunity of closely observing the working of the individual engines in question.

The higher cost of "60 per cent" for repairs to the American engines has next to be noticed; but as it raises rather a wide subject, and naturally leads up to the still wider aspect of the question American versus British locomotives as embodied in the "engine-off-the-peg" phrase used by the chairman of the Midland Railway, I shall reserve it for treatment in a subsequent communication.—The Engineer.

HORSEFLESH AS A FOOD.

THERE is a popular prejudice against the flesh of the horse as a food, and it is usually eaten knowingly only under compulsion, as in time of dearth or during a siege. Those who were in Paris in 1870, or in Ladysmith last year, know its taste well, but there are few who profess to like it. It appears from a series of experiments reported in the *Revue Générale des Sciences* (Paris), that the popular prejudice has some physiological foundation, since the experimenter, M. Pfüger, found that the exclusive use of horseflesh as a diet is injurious. As he has discovered a simple antidote to its harmful effects, however, the heroes of future sieges need not hesitate to employ it as a food. To quote the report:

"In the course of an interesting series of investigations on the phenomena of nutrition under various physiological conditions, M. Pfüger was led to feed dogs exclusively on horseflesh during several months.

"The animals thus fed diminished steadily in weight, no matter how large the quantity of meat eaten. . . . The quantity of nitrogen eliminated always exceeded that taken in the body, no matter how large this latter amount was, and this excess of eliminated nitrogen increased with the progress of the experiment.

"In dogs fed on horseflesh, intestinal troubles are constantly observed. This has also been noticed in certain zoological gardens where the carnivorous animals were fed on horseflesh.

"In an investigation of the cause of these phenomena, Pfüger was able to prove that they were present, whether the horseflesh was raw or cooked. He showed that they are due to the presence in horseflesh of some substances not yet determined, which are soluble both in water and in alcohol. When horseflesh has its extractive parts removed by water, a mass is left that has no injurious effects; but the bouillon produces them. The alcoholic precipitate of this bouillon is harmless, but the alcoholic liquid, after the alcohol has been removed, possesses the qualities of the meat itself. Pfüger, taking into consideration the poverty of horseflesh in fatty matter, thought at first that the cause of its injurious qualities was to be found in this lack. But by adding to the flesh fat taken from the same meat, he found that the injurious effects continued to

appear. On the other hand, by adding to the horseflesh a small quantity of the fat that envelops the kidney in mutton or beef, or the fat of pork, Pflüger was able to render horseflesh perfectly harmless. These different fats must, therefore, possess properties that are antitoxic to those of horseflesh.

"The practical outcome of this is that if we wish to use horseflesh as food, it is a good plan, to avoid intestinal troubles, to add the kidney fat of beef or mutton, in the proportion of 25 grammes (about an ounce) of fat to a kilogramme (2.2 pounds) of meat. It is also a good plan to boil the meat in water and to throw away the bouillon.

"Exactly what is the active substance in horseflesh, and what is the mechanism of its action? Pflüger gives some interesting considerations in this regard, but the question does not seem to us to have been yet definitely settled."—Translation made for The Literary Digest.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

The Manufacture of Bronze Powder in Germany.—One of the most important and interesting of the special forms of manufacture, for the product of which the United States is dependent upon Germany, is that of bronze powder, the shining metallic dust which is used for producing gilt and bronze effects in wall papers, letterpress printing, lithography, mirror and picture frames, fresco painting, and the artistic decoration of a vast range of manufactured articles in wood, paper, and various metals. For all these purposes, bronze powder offers the cheapest and most effective means of giving a surface effect of gilt or bronze, and its use has expanded with the rapidly increased production of articles of luxury and taste.

The principal seat of the bronze-powder manufacture is the city and vicinity of Fürth, in Bavaria, where the requisite water power and other conditions are favorable, and the industry is in the hands of an exceptionally intelligent and enterprising class of men, who have invented new machinery and improved methods until the whole process of manufacture is now mature, ably managed, and successful. The material used is so-called Dutch metal, an alloy of copper and spelter, in which the relative proportions of these are varied to produce the different colors desired. The larger the percentage of spelter, the lighter or more yellowish will be the tint of the alloy. The manufacturing process divides itself into two stages or branches, which are usually carried on in different establishments, viz., the preparation of leaf metal and the reduction of clippings of that material to the form of powder by milling.

The copper and spelter are smelted together in graphite crucibles, which are inserted in a large furnace heated by a strong coke fire. The crucibles contain about 400 pounds of metal, and when their contents are completely fused, they are run off into molds, which form half-round ingots 2 feet long by half an inch in thickness. After cooling, these ingots or rods are bound into bundles and sent to the rolling mill, where they are passed cold nine times through a double set of steel rolls under powerful pressure, by which they are flattened and drawn out into thin ribbons from 50 to 60 feet in length and sometimes more than 1 inch in width. Cold-rolling under such extreme pressure has the effect of rendering the metal brittle, and it therefore passes at this stage to the annealing furnace, which is heated by wood fire, as the sulphur in coal or coke would be injurious to the ribbons, which, having been softened and rendered ductile by annealing, are cleansed in an acid bath, cut into lengths of about 3 feet, and collected in bundles of 40 or 50 strips each. They are now laid between sheets of zinc, which are fastened together and passed under slinging hammers worked by water or steam power, by which the metal strips are beaten to a thickness of tissue paper. This process includes six successive beatings, and requires great skill on the part of the operatives to produce a uniform and unbroken foil. After the third beating, the metal strips are taken from between the sheets of zinc, loosened from each other, and cleansed by immersion in a bath of tannate of potassium. This cleaning is repeated after the sixth and last beating, and the sheets, thus cleansed from oxide and other impurities, are hung upon lines to dry. At the beginning, the rolled strips are of dull-gray metallic color; at the fourth beating, the yellowish color begins to show; and after the sixth, they are clear and bright as gold.

In view of the great variety of purposes for which bronze powder is employed, it is graded in respect to color into seven qualities or tints, ranging from bright copper red to golden yellow.

The material reaches the condition of thin sheets of leaf metal, 3 feet in length, widened by hammering between zinc plates from 1 inch to an average width of 8 inches. These, having been cleaned and dried, are carefully assorted, the defective leaves thrown out as waste or inferior material, and the perfect ones cut into small squares, which are laid together by hand in packets of several hundred each and inclosed within an envelope of sheet brass. Thus held together and protected, the packets are returned to the annealing furnace, where they are softened by heating and slow cooling, and then go to the beaters, where they are reduced, under flattening hammers, to the thinness of real gold leaf—so thin that it can be blown away by the breath. This completes the preparation of leaf metal, the finished material for bronze powder and other purposes, of which there are not less than a hundred manufacturers in the city and district of Fürth. This part of the industry dates from the sixteenth century, and has been built up by many generations of patient and skillful beaters of gold, silver, copper and other malleable metals.

The manufacture of bronze powder consists in grinding, clipping, and pulverizing the various bronze foils to an even, impalpable powder, and is an industry of comparatively recent date. The present perfection of methods and product has only been attained during the past thirty years. It began as a means of using up and utilizing the imperfect leaves which came as waste from the beaters of gold, silver, and bronze. These were cut by hand into fine clippings and then

ground to powder in handmills of simple construction. With the lapse of time and the spread of artistic industries, the uses of bronze powder increased until the demand far outran the supply of waste, and the leaf metal is now made on a large scale, specially as a material for this purpose. The beating process flattens out a pound of copper and spelter alloy to an area of about 500 square feet, and in this condition the square sheets, as they come from the brass envelopes, are sheared into small fragments and rubbed with olive oil through a steel sieve having ten meshes to the inch, and then passed to the stamping and grinding machines, where they are pulverized by steam or water power to the bronze powder of commerce. The grinding occupies from one to four hours, according to the grade or quality of the powder to be produced, which is of four grades—from coarse to superfine. The superfluous oil is removed by heating under pressure, and the powder is then carried into centrifugal classifiers, or grading machines, which, turning at a high speed, expel the powder through fine orifices in the form of dust, which settles on inclosed shelves, according to weight and fineness—the finer particles at the top, the coarser below—and in this way the powder is divided into the several grades of fineness and consequent value. Bronze powder and leaf metal are exported largely from Germany to the United States, the exports from Fürth alone during the fiscal year ended June 30, 1899, having reached a declared value of \$595,680.34, and of \$920,317 for the fiscal year 1900.—Frank H. Mason, Consul-General at Berlin.

Proposed Museum of American Goods at Calcutta.—The value of all manufactured goods imported into India during the year ended March 31, 1901, was about \$250,000,000. Of this, nearly 67 per cent came from the United Kingdom, while less than 2 per cent came from the United States. With well-directed efforts on the part of our manufacturers and exporters, they would soon secure a much larger proportion of this trade.

If a museum of American goods, similar to the Japanese museum in Bangkok, were established in Calcutta by a combination of United States manufacturers, where samples could be inspected and the goods delivered be compared with them, it would greatly increase our trade. It should be under the management of an experienced business man, with assistants acquainted with native merchants.

The United States is a large buyer of Indian products, taking about 60 per cent of the jute manufactures, in the form of gunny bags and cloth, and nearly 15 per cent of the raw jute exported, besides immense quantities of hides and skins; large shipments of indigo, tea, oils, and mica, as well as carpets, rugs, draperies, embroideries, curios, etc., amounting to about \$24,000,000 annually. There is no reason why we should not have a much larger proportion of the import trade.

If such a museum as I suggest were established here, embracing samples of iron and steel manufactures (in which we are successfully competing with all other countries), machinery, mill work, railway material, bridge work, agricultural implements, electrical supplies, wire fencing and other wire goods, hardware and cutlery, cotton piece goods and other cotton fabrics (of which there is such an enormous sale here), boots and shoes, enameled ware (to take the place of costly brass goods now in use), umbrellas (for which there is a great demand, as nearly every native, though half naked, will have a cheap umbrella), watches, clocks, toys of all kinds, and the hundreds of articles which will naturally suggest themselves to our manufacturers, it would soon increase our sales enormously. If a number of manufacturers should combine to establish such a museum, it would be comparatively inexpensive for each. Should manufacturers not combine, it would be a splendid enterprise for some energetic business man to make arrangements with as many manufacturers as possible to supply him with samples of their goods and to execute his orders. With a moderate capital he would soon build up a large and prosperous business.—R. F. Patterson, Consul-General at Calcutta.

Mercerized Cotton in Germany.—A German chemist and an Austrian mechanical engineer have invented an improved mercerizing process, and have obtained letters patent in all countries. They mix copper, ammonia, and cotton waste in a large vat. In about six hours a liquid of dark blue color is formed, which passes into a large filter press, and then out of small glass tubes through a mild sulphuric acid bath. It is then of a gelatinous consistency, and is caught by a small glass rod, in the hand of a boy or girl, and reeled onto a large glass spool, as it passes through the bath. The copper and ammonia, together with other chemicals, are deposited as a sediment, and are used again. As the threads are reeled, they receive a bath of cold water from a siphon. The numerous spools center on one large spool, and are then reeled onto another, and so on, always under cold water, until all chemicals and acids are removed. This stage of the process takes four hours. The thread is then taken to a drying room.

A corporation has been formed with a paid-up capital of 2,000,000 marks (\$476,000), called "Vereinigter Glanzstoff Fabriken"; it now has in operation a factory employing 400 hands, in the village of Dremen, 10 miles from Aix-la-Chapelle, and a factory employing an equal number of hands at Mülhausen, Alsace, Germany. My observation, while visiting the factory in this district, was that the employees were nearly all boys and girls, or unskilled labor. At present, I am informed by the inventors that they are unable to fill all the orders. They began exporting to the United States this year.

The product is brilliant in color and finish and of considerable textile strength. The thread consists of ten or twenty fibers twisted into one, but can be made of any desired thickness. They also make a thread called "horsehair artificial silk." The machines are small and compact, and are operated by ingeniously applied electric power. Each machine can be started or stopped without interference with the others.

The factory is built on the bank of a small stream,

which furnishes water power to run a large dynamo, the force being then distributed to small batteries on each machine. They are now manufacturing 600 pounds daily.

The present market price is about 60 per cent that of silk. The manufacturing rights for France have been sold for \$300,000. I understand that negotiations for the purchase of the United States patent are under way.—Frank M. Brundage, Consul at Aix-la-Chapelle.

New Railroads in Prussia and Saxony.—Consul Warner, of Leipzig, June 18, 1901, informs the Department that a commission of experts has just examined and accepted for the Prussian government the newly constructed railroad between Blankenstein and Marxgrün, a distance of about 7 miles. This line, the Consul adds, will afford a direct connection between Hof and Triptis, by way of Ziegenrück, Probstzella, and Leipzig, as well as improve the facilities for marketing goods produced in this district—southeastern Thuringia. The road is in a district celebrated for its beautiful scenery and visited annually by large numbers of tourists.

Mr. Warner also says that the Saxon government has established a regular train service on its newly constructed railroad connecting Altenburg, Langenleuba, Oberhain, and Narsdorf. This line, although of standard gage, is single track. It is about 20 miles in length, and has been built more for freight traffic than for passenger service, in order to develop the coal properties along the route and to encourage the growth of manufactures in a section which has heretofore been almost exclusively agricultural.

Testing Agricultural Implements in Russia.—Deputy Consul General Hanauer, of Frankfurt, under date of June 13, 1901, quotes from the German press that the Imperial Russian Agricultural Association has established, on its model farm near Moscow, a depot for testing agricultural machinery and implements, in order to learn which are the most suitable for Russian farm use. Manufacturers who wish to enter their machines for these tests are required to pay from 500 to 1,000 rubles (\$257.50 to \$515). This fee entitles them to enter all their machines for a period of three years, and, in addition to a space of 375 to 750 square feet in the exhibition building at the farm. The results of the tests will be made public, and the cost of printing and other outlays will be defrayed by the association, which will also bear the expenses incurred in taking care of the machines and their insurance against fire. Applications for entry should be addressed to Prince Alexander Scherbatoff, president of the society, Moscow.

Moscow Trade with the United States.—Deputy Consul-General Hanauer writes from Frankfurt, June 22, 1901:

According to correspondence from Russia, published in German papers, Moscow wholesale firms, which have imported agricultural machines and implements from the United States, have inquired of the American Consul at Moscow why the importation of these articles has almost entirely ceased. The Consul replied that the enhanced Russian duty was the cause. The Moscow district annually exports goods to the value of 8,000,000 rubles (\$4,120,000) to the United States, mainly consisting of wool, hides, pelts, and some manufactured articles. The Moscow merchants fear that, in consequence of the tariff differences existing between the two governments, the exports from the Moscow district will be greatly reduced this year.

Builders' Association in Austria.—The following has been received from Consul Hughes, of Coburg:

The master builders of Austria have determined to petition the government to allow the establishment of a national master builders' chamber (to a certain extent after the pattern of the chambers of commerce). The objects are to unite the master builders of the empire; to guard their interests legislatively and otherwise; to give information to the government as to building, labor, etc.; and to see that the building regulations are observed. The government, it is reported, will do everything in its power to promote the undertaking.

Canadian Discovery for Preserving Wood.—Commercial Agent Johnson, of Stanbridge, under date of June 25, 1901, reports a discovery for the preservation of wood. The sap is removed from timber, and at the same time it is impregnated with chemicals, to render the wood either fireproof or impervious to attacks of insects or to decay in salt or other waters. Beechwood can be made suitable for railway sleepers or for boat and shoe lasts. If necessary, the impregnating plant can be used at the felling ground. The cost of impregnating is about 2 cents per cubic foot; cost of plant, about \$1,000.

Exhibition at Dessau, Germany.—Consul Warner reports from Leipzig, June 6, 1901:

A general industrial and agricultural exhibition will be held at Dessau, Anhalt, from the 28th of September to the 7th of October, 1901. Detailed information may be obtained by writing to "Das Ausstellungs-Bureau, Hotel Kaiserhof, Dessau."

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- No. 1106, August 6.—Cotton in Central Asia.—The Mineral Resources of Palestine.—Leipzig Exhibit of Wearing Apparel.—New Insulating Material.—German Lace Industry.—Bids for Rolling Stock for Belgian Roads.
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- No. 1110, August 10.—Chicle Gum in Mexico.—Live stock and Forestry in Eastern Siberia.—Congress of Historical Sciences at Rome.
- The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

Intensifying Negatives Without Mercury.—Dissolve 1 part of iodine and 2 parts of potassium iodide in 10 parts of water. When required for use, dilute 1 part of this solution with 100 parts of water. Wash the negative well and place in this bath, allowing it to remain until it has become entirely yellow, and the image appears purely dark yellow on a light-yellow ground. The negative should then be washed in water until the latter runs off clearly, when it is floated with the following solution until the whole of the image has become uniformly brown.

Schlippe's salt 60 grains
Water 1 ounce
Caustic soda solution, 10 per cent. . . 6 drops

Finally the negative is again thoroughly washed and dried. The addition of the small quantity of caustic soda is to prevent surface crystallization. It is claimed that with this intensifier the operation may be carried out to a greater extent than with bichloride of mercury; that it gives clear shadows, and that it possesses the special advantage of removing entirely any yellow stain the negative may have acquired during development and fixing. Furthermore, with this intensifying method it is not necessary to wash the negative, even after fixing, as carefully as in the case of the intensifying processes with mercury, because small traces of hypo which may have been left in the film will be rendered innocuous by the free iodine. The iodine solution may be employed repeatedly if its strength is kept up by the addition of concentrated stock solution.

Poultry Powder.

1. Cayenne pepper 2 ounces
Allspice 4 ounces
Ginger 6 ounces

Powder and mix well together. A teaspoonful to be mixed with every pound of food, and fed two or three times a week. Also feed fresh meat, finely chopped.

2. Powdered egg shells 4 ounces
Powdered capsicum 4 ounces
Sulphate of iron 4 ounces
Powdered fenugreek 2 ounces
Powdered black pepper 1 ounce
Sand 2 ounces
Powdered dog biscuit 6 ounces

A tablespoonful to be mixed with sufficient meal or porridge to feed 20 hens.

3. Powdered mustard 20 ounces
Powdered fenugreek 15 ounces
Ground oyster shells 12 ounces
Ground bone 8 ounces
Powdered sodium sulphate 4 ounces
Powdered capsicum 10 ounces
Sulphate of antimony 10 ounces
Ferric oxide 10 ounces
Corn flour 20 ounces
Powdered gum asafetida 1 ounce

4. Bone, ground, or slacked lime. . 12 ounces
Gentian, powdered 1 ounce
Capsicum, powdered 1 ounce
Ginger, powdered 2 ounces
Sulphur 1 ounce

Put a teaspoonful in a quart of food. Here is a formula for an "egg food":

5. Ground bone or phosphate of lime 12 ounces
Capsicum 1 ounce
Ginger 2 ounces
Cantharides 1 drachm
Potassium nitrate 1 ounce

Put a teaspoonful in a quart of food.

—Pharmaceutical Era.

Effervescent Quinine Solution.

Quinine sulphate 1 drachm.
Citric acid 2½ drachms.
Syrup of orange peel ½ drachm.
Water, enough to make 5 drachms.

Five minims of this solution contains 1 grain of quinine (reckoned as sulphate). The dose being apportioned, dissolve in a few ounces of water 3 grains of sodium bicarbonate for every grain of quinine and add to this the quinine solution, when effervescence ensues.

Dressing for Morocco or Kid.

Shellac 2 parts.
Benzoin 2 parts.
Yellow wax 5 parts.
Soap liniment 7 parts.
Alcohol 600 parts.

Digest until solution is effected, then allow the liquid to stand in a cool place for 12 hours and strain. Apply with a bit of sponge, or soft rag; spread thinly and evenly over the surface, without rubbing much. If dirty, the leather should first be washed with a little soft soap and warm water, wiped well, and allowed to dry thoroughly before the dressing is put on.

Liquid Gilding for Backboards.

To 7 parts of slate in very fine powder add 1 part of lamp-black, and mix with enough solution of water glass, 1 in 8, to give a liquid of proper consistence for application with the brush. The surface to which this is applied, preferably tin or zinc, is made rough by rubbing with sandstone or coarse emery, and the material is applied in two or more coats, letting each dry thoroughly before applying another. If necessary, rub down the final coat to make a smooth surface.

To Remove Warts.

Sulphur 10 parts.
Acetic acid 5 parts.
Glycerin 25 parts.

Keep the warts covered with this mixture.

Ink Which Will Copy on Dry Paper.

Anilin black, water-soluble 30 parts.
Anilin blue, water-soluble 2 parts.
Ammonia alum 16 parts.
Glycerin 1,000 parts.
Water, enough to make 3,000 parts.

—Druggists' Circular.

VALUABLE BOOKS

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